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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to assure publication in that week's issue.

COMMENCEMENT TIME.

The present month will see a resumption of work at practically all of our institutions of learning. While discussions have been going on during the vacation season among professional men of every class, there is no department of progress in which more discussion has been raised than in the allied departments of engineering. On the one hand, a set of men properly recognized for their astuteness, declares that only an education very broad in its nature can fit a young man for the battle of life. On the other hand, a set of men equally astute, is proclaiming for specialization along this or that line. Let us hope that the end of another school year will see all of our institutions better equipped to fit the young man for his life work, whether it be as a specialist or as a practitioner on extremely broad lines.

ECONOMICS IN ELECTRICAL ILLUMINATION.

The inefficiency of electric lighting is too well known to need comment, as although electric lights are more efficient than other artificial illuminants, according to our present knowledge only about ten per cent of the electrical energy furnished to the lamp is converted into light. This inefficiency is particularly unfortunate in electric lighting, because it necessitates large installations of costly apparatus, and as the large loss takes place at the lamp itself, it is necessary for all intermediate apparatus to be able to transmit all the lost energy, as well as that which is converted into light. The problem, then, of bringing about marked economies in electric lighting is perhaps second only in importance to that of the more efficient conversion of the potential energy of coal into a more useful form.

New Types of Lamps.

The importance of this problem has been recognized and much time and ingenuity have been expended in improving the various appliances made use of. The incandescent lamp using a carbon filament has been wonderfully improved in all respects. Arc lamps have not been neglected, and experimentation has been carried out along other lines to test the possibility of other means for converting electrical energy into light. We have thus the lamps of the Nernst type, where the luminous portion is a conductor at high temperatures only; the mercury vapor lamp, and the vacuum tube lamp, which is yet in an experimental stage.

Improvements in the Incandescent Lamp Attempted.

The simplicity of the incandescent lamp had led to attempts to combine with the advantage of this type of lamp the high efficiency of the incandescent mantles; and a few years ago an incandescent lamp which was said to have a filament consisting of a carbide of rare earths was described in the technical press. This, it was stated, had a high efficiency and a reasonable life, and was not unduly expensive; but, for some reason or other, the lamp has not been put on the market.

High-Efficiency Arc Lamps.

This same line of work has been extended to the arc lamp, and certain ingredients added to the carbon which give it a higher luminous efficiency. A notable type of this lamp is the Bremer arc lamp, which has found considerable application abroad, but only to a restricted extent in this country. Also a better distribution of light has been obtained, giving a better illumination for the same number of lights.

Importance of Improved Efficiency in the Lamp.

Improvements of this kind are, of course, important, although they only increase the total efficiency to a comparatively small extent. To double the efficiency of a lamp would double the output of every lighting station, and would far more than double the number of lamps used. But an efficiency of even twenty per cent is very far from what we should endeavor to reach.

Improvements in Other Apparatus.

While work is going on in improving the lamp and in search for new and more efficient lamps, other departments of lighting are not being neglected. There has been a wonderful development in the prime mover. The gas engine has been developed from the small size of ten or twenty horse-power to units with a capacity of several thousand horse-power. The steam turbine, after long and patient work, has been brought to a practical state, and there seems to be little hope for much change in prime movers, unless there should be a complete revolution in our methods of converting heat energy into mechanical energy.

Economies in Other Lines.

There have also been improvements in the lamps, tending to decrease the cost of

maintenance and attendance. In this country the enclosed arc lamp, which will burn for a long time without attention, has been widely adopted. In Europe a long-burning open arc lamp has been developed to compete with the enclosed arc lamp, the construction being such that much longer carbons are used. There are lamps now burning forty and sixty hours, and it is stated that eighty-hour lamps may be forthcoming.

These improvements, as well as others, have reduced the cost at the station, and in this way brought about a considerable reduction in the cost of electric lights; but we are still far from the final solution. What is being sought and what will doubtless be found some day will be the cold light—that is, the lamp to which energy in some convenient form can be supplied, and which will convert a large percentage of this into luminous rays. It is possible that some of the recent discoveries connected with invisible rays may suggest lines of work which will be fruitful. Thus, the so-called N-rays discovered by Blondlot are known to increase the luminous intensity of a glowing body without increasing its temperature. This implies a higher efficiency, whether it be due to a more efficient transformation of the energy the body received before these rays were allowed to fall upon it, or whether it be due to the conversion of these invisible rays—which before were going to waste—into luminous rays. The problem is undoubtedly one of the most important which is facing the engineer and scientist to-day, and no line of investigation which promises the least improvement should be neglected.

It is difficult to foresee the effect the steam turbine will have upon the power station of the future. That it will be an important factor can not be doubted, but it has a strong rival in the gas engine. It is probable that further knowledge of the capabilities of the two types of motor will result in consigning to each its own particular field of usefulness. Further than this the gas turbine is yet to demonstrate its usefulness and practicability. It is likely that it will bear the same relation to the gas engine that the steam turbine does to the steam engine.

THE CONVENTION OF THE AMERICAN STREET RAILWAY ASSOCIATION.

The convention of the American Street Railway Association, holding forth at Saratoga, N. Y., this week, September 2, 3 and 4, will go down in history as another of a long series of meetings which has brought about a better understanding of the ethics of street railway operation. This is the fundamental and essential condition which such gatherings as this are designed to bring about.

The Papers Read.

It is the duty, year after year, of the committee in charge of formulating plans for the convention to bring before the assembly such topics for presentation and discussion as will best serve to show the way to higher efficiency and point out past errors, that newcomers in the field may not fall by the way. The transactions of the American Street Railway Association form a literature which is of inestimable value to street railway students, both in the direction of engineering and economics. The programme for this year does not fall behind those which have gone before in point of variety and in value to the operating railway man.

The Entertainment Provided.

A notable feature of the conventions is the entertainment that is always provided, which, while a side issue, is of great importance in making for harmony and in relieving the stress of what would otherwise be a monotonous attention to detail.

Exhibits of Apparatus.

Another important function which these gatherings have to deal with is the exploiting by manufacturers of all that is new and all that is good in the street railway and kindred lines, for the manager to become acquainted with. The convention brings to a central point the developments of years, and gives a close-range view of a broad line of manufacture.

While the programme committee is to be congratulated upon the presentation of a fine list of topics for serious discussion, the local committees and exhibitors are entitled to a great deal of praise for the efforts they have made to provide an attractive quality of entertainment and a noteworthy exhibit of appliances.

SURFACE CONTACT SYSTEMS IN PARIS.

In this issue our special correspondent at Paris contributes a noteworthy article dealing with two of the surface contact systems of electric traction which have been in successful operation for some time in Paris, France. These are the Diatto system and the Clairet-Vuilleumier system. The Diatto system uses direct current at 550 volts. A number of circular contact blocks are laid between the rails, and a long contact bar, carried under the car, passes over the blocks and brings the current to the motors. The mechanism for distributing the current from the underground feeder to each block as the car passes is contained within the block itself. This consists essentially of an iron plunger which is raised by a magnetized bar carried on the car, and thus completes the circuit for the block. A separate battery is carried on the car, and is used to magnetize the bar which is suspended from the car and which makes contact with the surface blocks. This battery is small, consisting of but eight cells giving eight amperes at sixteen volts.

Distributor System from Station Points.

The Clairet-Vuilleumier system operates also with direct current at 550 volts. Current is sent from an underground feeder to a series of distributors or automatic relays which are placed along the track 100 metres apart. From the distributors a series of small wires is connected and supplies current to each of the contact blocks placed between the rails. These contacts are formed of a small metallic block embedded in the pavement, and are slightly raised above the surface, so that the contact rail which the car carries underneath it can rub over the upper surface. The succession of blocks, each of which receives the current only at the instant when the car passes over it, serves to distribute the current for the motors. As the car continues on its course, its contact rail touches a block which is immediately in front, without having left the preceding one. As the forward contact is connected to the distributor by one of the wires a small portion of current is shunted into the distributor and serves to operate a fine-wire electromagnet of high

resistance, which forms part of the distributor. The latter acts as a relay and sends the main current into the new block, cutting it off from the receding one. This cycle is repeated as the car proceeds.

The Faults of the Surface Contact System.

A great deal has been said, from time to time, for and against surface contact systems of any description. With the great simplicity of the overhead trolley, where this will be allowed, and the entirely satisfactory service which the third rail gives when properly installed, it is hard to see wherein the surface contact system has any advantage, except from an æsthetic point of view. It certainly is expensive to install, and while there is really nothing in the construction detail of the line and its auxiliary apparatus which is not doing eminently satisfactory work in segregated installations, the combination of the working parts necessary to produce a highly insulated, workable surface contact system is a proposition which calls for an apparatus as delicate in its movement as the works of a watch, and as enduring in its operation as the motor on the car.

Troubles from "Sticking" of Contacts.

In all surface contact systems which make use of electromagnetic devices there is the ever-present tendency to "sticking" of contacts, which is liable to send current to almost any point other than where it is wanted. This may render the system dangerous, or it may simply mean a waste of energy. A great deal of study and mechanical ingenuity have been given up to the elimination of this unacceptable feature, and the systems above noted present working ideas which are well worthy of close investigation.

INTERFERENCE IN WIRELESS TELEGRAPHY.

There seems to have entered the electrical field, along with wireless transmission, a new element—that of unnecessary, and perhaps vicious, interference with a competitor's service. The ease with which electric waves can be sent off into air space and neutralize or render unintelligible legitimate messages sent out by a rival in the same vicinity, apparently has been a temptation too great to be withstood, and during the recent yacht races, on one or two days, wireless transmission to land from boats was a failure. On other occasions, particularly the first and last days, the news was promptly sent out and received. We hope that for the proper advancement of the art, as well as for the honor of the profession, the wireless telegraph companies will reach a better understanding, and that if there have really been any of these dog-in-the-manger tactics, they will instantly cease. They are not at all creditable.

THE GAS ENGINE AND THE GAS TURBINE.

BY GEORGE E. WALSH.

The merits of the steam turbine have been thoroughly tested and demonstrated, and the gas engine of both small and large units has been developed to the point of great practical efficiency; but the gas turbine is still an unknown and uncertain factor in power production. Nevertheless, engineers are turning their attention with renewed interest to the gas turbine, and it is confidently believed that within a short time satisfactory gas turbines will be in operation for running electrical stations. If the gas turbine is an ultimate success it will be the nearest approach of any invention yet made to convert directly the energy of coal into electrical energy.

The gas turbine can be used only when the problem has been solved of producing a continuous combustion of gas under pressure and complete control. At present the gas engine is operated by a series of explosions, one for each two revolutions. It is generally a single-acting, reciprocating machine, and not double-acting as the steam engine; but it possesses other features which more than compensate for this loss. The working pressure in the gas engine is much higher than in the steam engine, and its actual performance is oftentimes greater. The high temperatures under which the gas engine works necessitate the employment of a water-cooling jacket, which causes a loss of one-fifth of the heat delivered to the engine.

The gas turbine should avoid many of the drawbacks of the gas engine, and engineers seem to expect soon to be able to burn gas in such a continuous stream that it will be useful in the turbine form of engine. Already gas has been burned under mechanical conditions in laboratories which would indicate success in this direction. The question of reducing the high temperature in the cylinder chamber produced by the combustion of the gas is not so easily answered. The cooling water-jacket could not be used so readily in a gas turbine as in the gas engine. This loss, however, could be met if the turbine worked successfully otherwise. Until some new method of reducing the high temperature of the cylinder chamber can be invented, the circulation of cooling water will have to be resorted to.

The future of the gas engine itself is far more promising to-day than any other form of power producer; but as a formidable rival of the steam engine it enjoys the unique distinction of being so new in the field that tests have been only partly demonstrated. Both forms of engines have under test given one horse-power for about one pound of coal. Furthermore, the efficiency of both the gas engine and the best types of steam engines has been, between the coal pile and the point of delivery, nearly or quite twenty per cent. The steam engine has accomplished these results for some time past, and the gas engine only comparatively recently. The steam engine has been developed and improved until it would seem as if it had reached the ultimate goal of its efficiency. On the other hand the gas engine has proved its claim to instant recognition at a period in its development when it might be said that it is in its infancy.

Under commercial conditions the gas engine appears to be susceptible to infinite improvements and developments. The adaptability of the gas engine to different kinds of work has been not the least of its good points. Probably the most important field is that of utilizing blast furnace gas. The simplicity of the engines adapted to this use makes it of special value. The pig iron produced in this country is enormous, and the cost in fuel far beyond what it should be. The waste of the gas represents unharnessed power that for generations has been wasted. The employment of this to operate gas engines of small and large units will shortly revolutionize the business. Not only in this country, but in England and Germany, the waste gas of the blast furnaces has not until recently been harnessed. In Germany alone it is estimated that some 600,000 horse-power is wasted annually in making the 8,000,000 tons of pig iron, while in this country the loss in this way is much greater.

The prediction is freely made by experts that in a comparatively short time

the production of pig iron will be of secondary importance to the generation of gas by the blast furnaces for operating gas engines. In other words, the gas will be of more value than the pig iron. All this gas has been wasted in the past, except such little as was recovered for burning in an uncertain sort of a way for operating blowers and furnace blasts. By burning the gas direct to run gas engines the waste can be reduced to a minimum, which enables operators to sell power for an infinite variety of manufactures.

There is a wide range of temperature in which the gas engine can be used. This enables the manufacturers to use the machines in mills and factories under conditions not found possible with steam. Recently the application of highly superheated steam has enabled mill men to use steam under new conditions, but it is possible that the limit of possible heat efficiency has been reached in this direction.

There are several types of blast-furnace engines which fully illustrate the practical development of this form of power production. More of these engines of large units are used in Germany for driving electrical generators than in this country. They have been found to possess economy and efficiency for this work not equaled by any other engine. In this country many of these different types of gas engines are being installed for electrical generating, and within a few years their appearance will be quite common in all parts of the country. They are built to burn both blast-furnace gas and ordinary illuminating, producer and natural gas. In the Pennsylvania iron region dozens of the largest gas engines have been installed during the current year, and others are being erected as rapidly as possible. In the natural gas belt they are also being constructed to operate the electrical and steam pumps used for pumping of the gas from great depths. The gradual decline in the pressure of the natural gas has compelled owners to resort to pumping and sometimes the pressure required to force the gas to a considerable distance for consumers is so great that the mammoth pumps represent unusual power. In the cities gas engines of smaller type are mostly used, for their work is generally lighter, and they burn for the most part ordinary illuminating gas.

There is such a wide selection of gas engines to-day that the engineer can find in some of them almost all of the latest improvements. On the other hand, with the multiplication of systems of gas engines there comes more difficulty in deciding about the relative merits of each. This will become more difficult in the near future, for with the rapidly increasing demand for this form of power producer there is a wide attempt to manufacture them to meet the needs of manufacturers. The question of which type or system of gas engine is the most satisfactory can not easily be answered to-day, and probably no one is most satisfactory for all work. The tendency will be to specialize the engines more and more to adapt them to different kinds of work. This has already proceeded to some considerable extent owing to the nature of the gas used. We have engines peculiarly adaptable to the natural gas region where the combustion of the gas differs materially from that from the blast furnace. Engines adapted to the blast-furnace gas consumption are more numerous than any other, and they will probably increase in numbers and improvements faster than those used in other industries.

Engines run by producer gas, where the fuel is burnt directly to make the gas for the engines, must show the largest amount of efficiency for a given consumption of gas. Where the outlay for fuel is direct there must be economy in its use, and all waste in the combustion must be eliminated. Probably in this field builders of gas engines will show their greatest skill and ingenuity in reducing the cost of operation. The quality of producer gas differs materially, and the engines will have to be made to utilize gas that shows a difference in calorific power of from ten to fifty per cent. The cost of the coal or other fuel for generating the gas must always enter largely into this question.

The size of the engine and the purpose to which it is put are questions which also obtrude very prominently in the whole matter, and figures submitted by experimenters in the past have hardly sufficient verification to apply in all individual cases. The gas engine is still too much in its infancy as a practical working machine to establish inflexible rules about its actual work under widely different conditions. In the large engines the rate of consumption of both gas and oil has been greatly reduced by the modern improvements, and the economy effected in this way shows definite results in the course of a year's operation. The tendency is probably toward the adoption of the open double-acting four-cycle engines for plants that require only small engines of 300 to 400 horse-power, and for very large power of 1,000 horse-power and upward the two-cycle engines. This selection of course is modified by conditions that pertain to different industries.

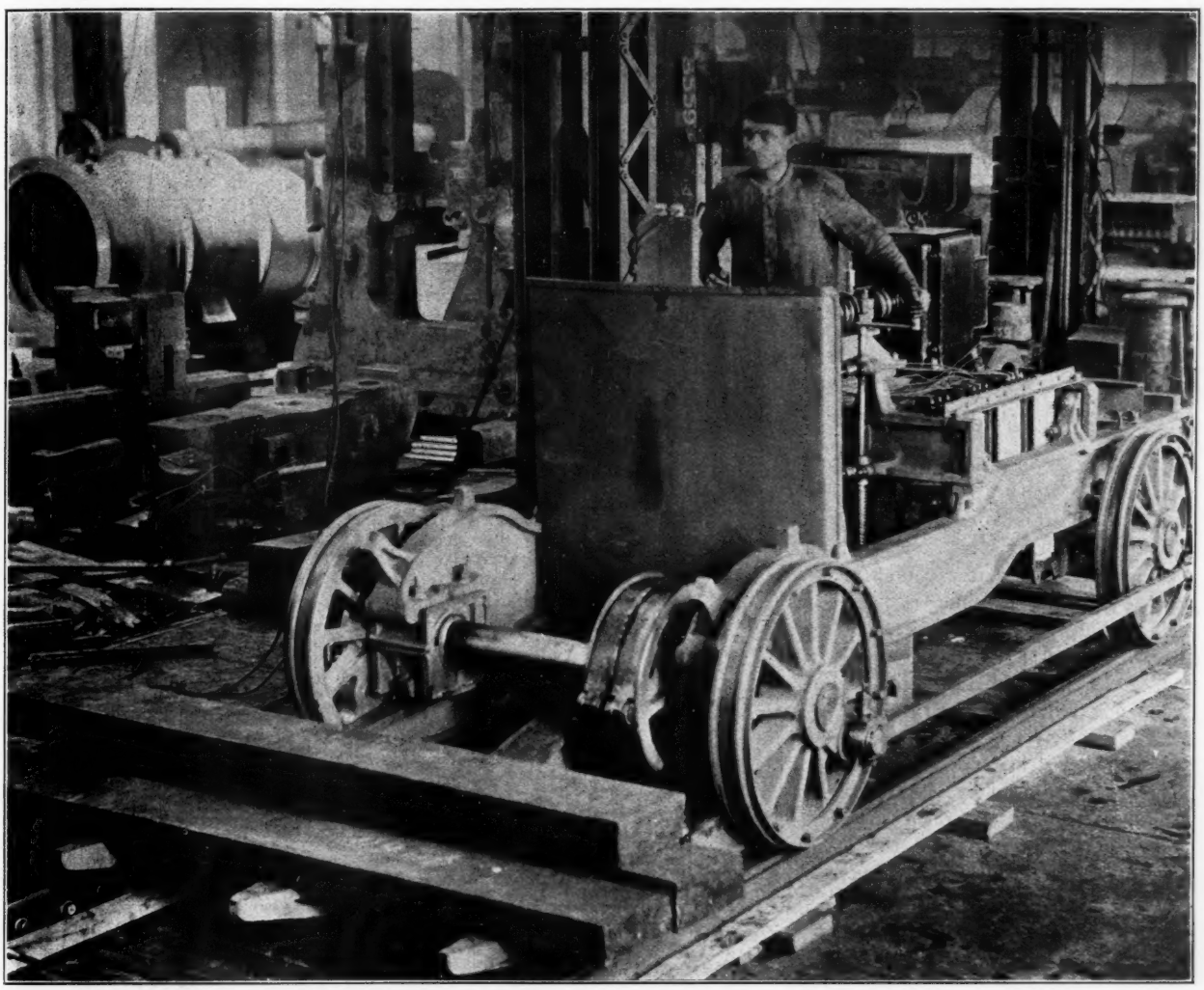
Central Electric Power Stations for Gold Mines.

In the use of electric power, says the London *Electrical Review,* in discussing a paper read by J. W. Kirkland, on "Central Electric Power Stations for Gold Mines," it was not claimed that it was universally applicable. The author excepted surface hoisting and rock drills. He does not think electric drills can compete with air drills, for although the electric drill is far more efficient than the best compressed-air drill, the essential features of a drill are that hard blows shall be given and the apparatus producing the blows shall be light. For these points, the air drills excel. Contrary to the usual opinion the power required for the stamp mill does not constitute the bulk of that used at a mine. Figures are given which indicate that the stamps take only about half the power used in the mill itself and but about one-quarter of that required in the mill and mine together. As regards the methods of transmitting power, the author does not think that rope or compressed air can compare with electricity. For driving the stamps the steam engine system lacks flexibility, and as it for a considerable part of the time is loaded to only a fraction of its maximum, it is inefficient. With a motor drive the motor may be subdivided and efficiency of operation kept high. The essential requirements for the mill are that it shall be close to the shafts, have ample water supply and be erected on sloping ground if possible. On the other hand, the power-house should be near the railway to permit of economical handling of coal. These conditions are easily met with in an electrical plant, but rather hard to meet if another system is adopted. The mill as a whole provides a fairly steady load, so that fairly large generators with a high efficiency may be used. The steam turbine was favored for driving the generators as compared with the condensing Corliss engine, as the former has a flat efficiency curve. In estimating the efficiency of such a system the efficiency of a generator was taken at ninety-four per cent and assuming 5,000 volts as the pressure, that of the transmission line, ninety-five per cent. The transformers, ninety-eight per cent; low-voltage distribution, ninety-eight per cent; motors, eighty-eight per cent; making a total efficiency of seventy-seven and one-half per cent. The efficiency of a line shaft drive should be from eighty to eighty-five per cent.

Electric Power in Modern German and English Iron and Steel Plants.

By Frank C. Perkins.

MANY of the largest iron and steel plants in America, as well as in England and in Germany, are now using electric power to a great extent in all parts of the works. Central power plants have been constructed operating electric generators by steam engines as well as gas engines.



ELECTRIC TRANSFER CAR FOR BLOOMS OF 3,000 KILOGRAMMES, AT DIFFERDINGEN, GERMANY.

A 600-horse-power, tandem gas engine, using blast-furnace gases, is located at the plant of Gebr. Rochling Hüttenwerk at Volklingen in Saargebiet. It drives a polyphase alternating-current generator at a speed of 120 revolutions per minute, which delivers a three-phase current at 450 volts pressure. This current is conducted about the plant by overhead and underground cables for supplying current to the numerous motors in use.

It may be of interest to consider some of the details of construction and arrangement of the Differdingen plant owned by the Deutsch-Luxemburgischen Bergwerks-und Hütten-Aktien-Gesellschaft. This rolling mill was equipped by the Duisburger Maschinenbau-Aktien-Gesellschaft, formerly Bechem & Keetman, of Duisburg. The main blooming mill has rolls 1,100 millimetres (43.3 inches) in diameter and 2,750 millimetres (nine feet) in length with hydraulic power for operating the screwing gear.

The blooming mill is operated by a double reversing steam engine with cylinders 1,200 millimetres (47.25 inches) in diameter and a stroke of 1,400 millimetres (fifty-five inches). This engine was built by the Elsässischen Maschinenfabrik, of Mülhausen i.Els. It operates at any speed up to 150 revolutions per minute and has a capacity of 5,000 horsepower.

The live rollers for the cogging mill are also operated by a double reversible steam engine. This engine has cylinders 280 millimetres (11.02 inches) in diameter and a stroke of 450 millimetres (17.7 inches). When the blooms have been rolled to a length of twenty-five metres (eighty-two feet) a set of transfer rolls conveys the iron to the hydraulic shears. Directly back of these shears there is a set of transfer rolls, eight metres in length, which is electrically operated.

About fifty-five metres (180 feet) from the blooming mill there are two Toehr mills between which is mounted a double tandem reversing engine with high-pressure and low-pressure cylinders, 860 millimetres (33.9 inches) and 1,350 millimetres (fifty-three inches) in diameter, respectively. This engine has a stroke of 1,250 millimetres (forty-nine inches) and

was built by the Maschinenfabrik Sach & Kiefselbach, of Rath. On one side it is directly connected to a billet mill and on the other side a mill with rolls 700 millimetres (twenty-eight inches) in diameter. The billet mill can handle 400 tons in twenty-four hours, rolling the material to fifty millimetres (two inches) cross-section. On both sides of this mill there are two sets of electrically driven live rolls. The set of rolls in front of the mill is twenty-two metres (seventy feet) in length and behind the mill twenty-four metres (seventy-seven feet) in length. The set of transfer rolls is 108 metres (346 feet) in length. The live rolls as well as the billet shears are operated by electric motors. The pendulum shears are also electrically driven and an electric bloom transfer car is employed for carrying the material from the bloom shears which are operated by hydraulic power.

The Siemens gas reheating furnace is served by a Welman charging machine of American make and it is stated that one man can charge the furnace with 600 blooms in twelve hours. The electric bloom transport car has a capacity for blooms weighing 3,000 kilogrammes. The most modern equipped iron and steel plants, both in this country and in Europe, are now using electricity extensively throughout the various buildings.

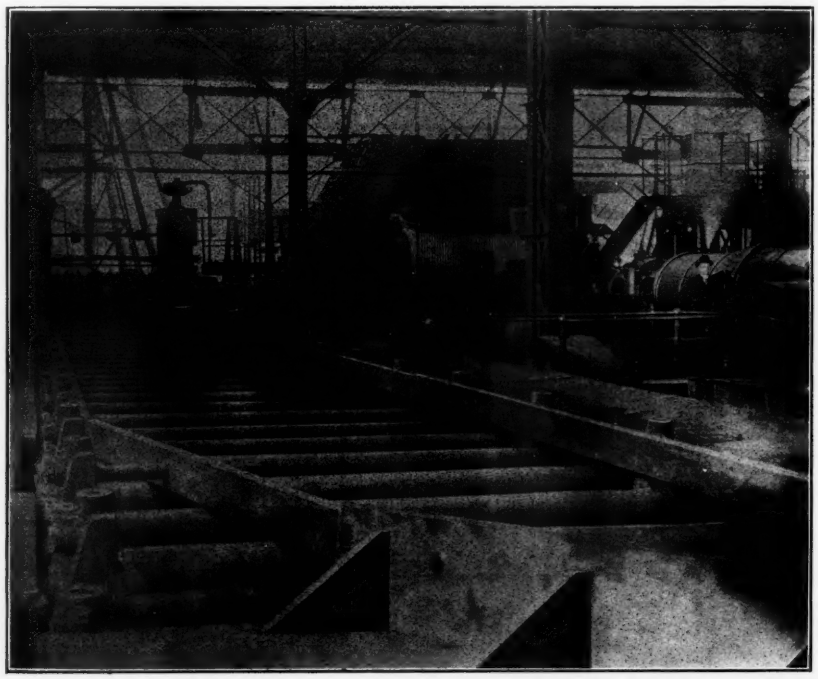
The electric cranes at Differdingen are of thirty-five and forty tons capacity and are driven by several electric motors of varying capacity, lifting, transverse and other motions required in the regular work. All recently constructed plants are equipped with electric ladle cranes, adjusting cranes, loading cranes and transfer cranes, while the latest ingot charging cranes, as well as those for the reheating furnaces, are all electrically operated.

In many plants the boring machines, cutting machines, punching presses, as well as the straightening presses and cold shears, are driven by electric motors of either direct or alternating-current types. There is little question that with the present electrical progress modern steel plants will use electric power more and more.

The power plant of the Port Talbot Iron and Steel Company, Limited, of South Wales, consists of a horizontal, long-stroke, compound engine developing 550 indicated horse-power, driving two 150-kilowatt continuous-current dynamos by rope transmission. The main switchboard is provided with instruments and switches for controlling current for power and lighting about the plant.

The overhead and other cables in the mill supply current to a twenty-five three-motor electric crane over casting pit, a twenty-five-ton three-motor electric crane over the rolling mill, and a ten-ton three-motor electric crane at the reheating furnaces, while one five-ton three-motor electric crane was placed over the reheating furnaces.

The motor equipment includes one eighty-horse-power motor for hot saw, two fifty-horse-power motors for blowers, and twelve twenty to thirty-horse-power motors for live roll and pullover gear. There is also a twenty-horse-power motor for engineers' shop, a twenty-horse-power motor for the dolomite mill, and a twenty-horse-power motor for tin-plate shears and stone-crushers.



ROLLING MILL AND REVERSIBLE ENGINE AT DIFFERDINGEN, GERMANY.

A twenty-horse-power motor is used for one straightening machine and a three-horse-power motor for another, while one twenty-horse-power motor is employed for roll-turning lathes and two twenty-horse-power motors for the screw-down gear on rolls.

In addition to the above a ten-horse-power motor drives the cold saw, and the scull-breaking winch is driven by a twelve-horse-power machine. These motors and generators were built by Ernest Scott & Mountain, Limited, of Newcastle-on-Tyne. The engine is of the horizontal long stroke, coupled compound type (non-condensing).

The diameter of horse-power cylinder is nineteen inches and that of the light power cylinder thirty inches, while the length of stroke measures forty inches. The engine operates at ninety revolutions per minute, and the steam pressure is 140 pounds per square inch.

The engine develops 550 indicated horse-power, and has a rope flywheel sixteen feet diameter, the number of ropes being fourteen, and the diameter of ropes one and one-half inches. The engine is fitted with Richardson & Rowland's automatic trip expansion gear to both cylinders.

The dynamo includes two six-pole, continuous-current, compound-wound machines, and each machine is constructed to give an output of 150 kilowatts. The current of each dynamo in amperes is 600 and the potential is 250 volts. They operate at 450 revolutions per minute and develop a total output of 300 kilowatts.

The object in arranging the two dynamos as installed is to enable the total capacity of the plant to be divided into two units, so that in the event of an accident, one machine would be capable of doing the bulk of the work. The machines are constructed so that either can be uncoupled in a few minutes, as the pulley shaft runs between the two centre bearings, and is made with a solid forged coupling at each end to attach to the two armature shafts.

The dynamos are fitted with four bearings, of the self-oiling, self-aligning type, and with rope-driving pulley grooved to

receive fourteen driving ropes, each rope being one and one-half inches diameter. The dynamos are mounted on a cast-iron sliding bedplate, with tightening screws and brackets for taking up the slack of the ropes while the machines are running.

An auxiliary lighting plant is provided, although the lights in the mill can be run from the main generators, suitable provision being made for this on the switchboard. The auxiliary lighting plant consists of a Scott & Mountain single-cylinder, vertical engine, and a four-pole dynamo. The steam cylinder is ten inches in diameter and it has a length of stroke of nine inches. It operates at 300 revolutions per minute, the steam pressure being 140 pounds per square inch and develops forty-five effective horse-power.

The engine is fitted with Pickering governor and equilibrium throttle valve, is complete with flywheel of suitable diameter, and drives, by means of a belt, the lighting dynamo.

The lighting dynamo is a four-pole, compound-wound machine and develops twenty-five kilowatts. The voltage is 250 and the current 100 amperes, while the speed is 900 revolutions per minute. The dynamo has self-oiling bearings and sliding bedplate, with sliding bedplate with tightening screws and brackets for taking up the slack of the belt.

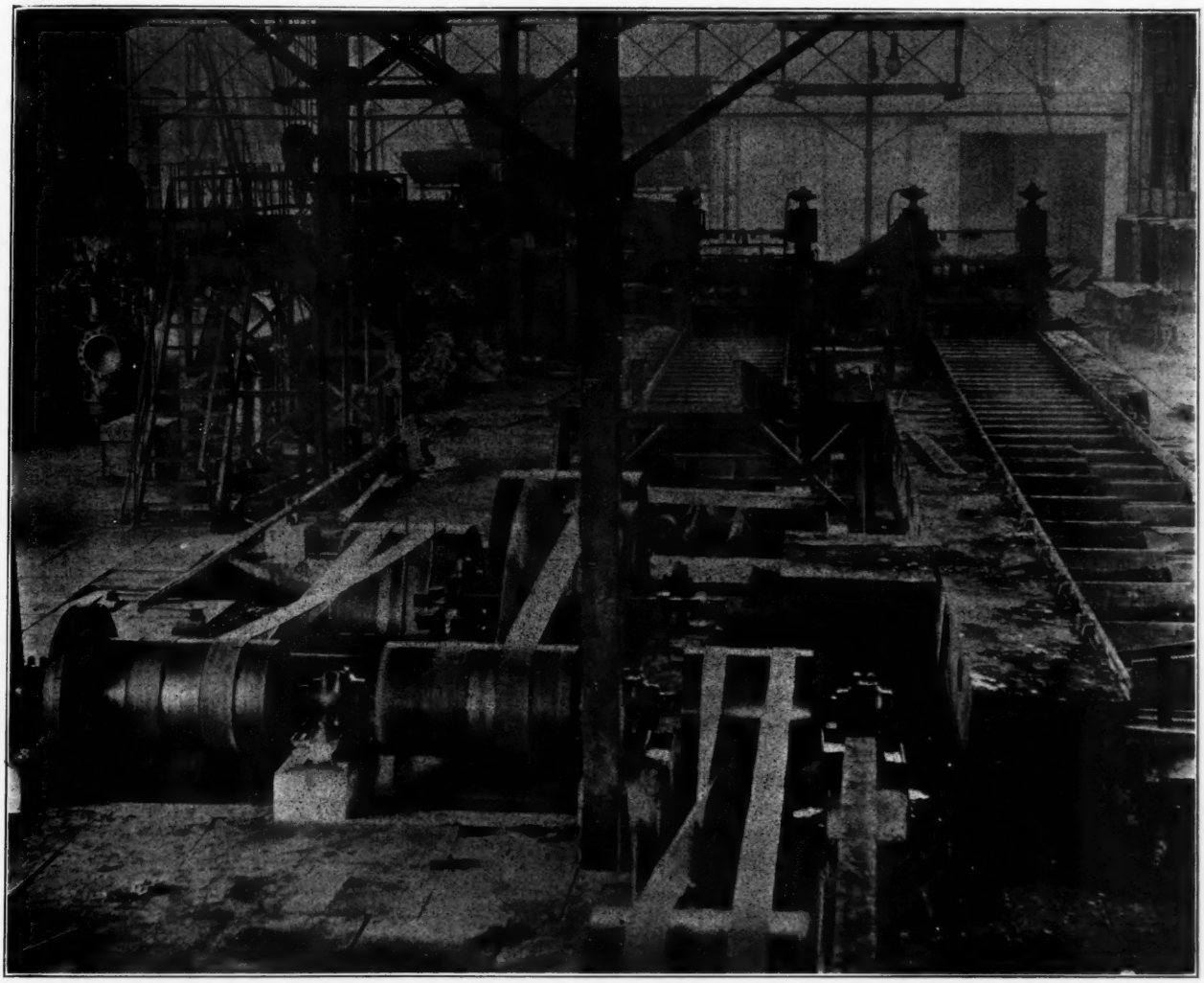
The main switchboard, which is fitted in the power-house, is arranged to control both the power and lighting circuits, and is constructed so that the main generators can be run in parallel or independently, or the lighting can be worked from either the power generators or the auxiliary lighting dynamo, as desired. The board consists of four white marble panels mounted in angle steel framing.

On each of the main generator panels are mounted a double-pole, quick-break lever switch, suitable for a current of 800 amperes, and a single-pole equalizing switch for running the dynamos in parallel. There is also an automatic overload and reverse current circuit-breaker, for 800 amperes, and an amperemeter to read to 800 amperes, as well as a voltmeter to read to 300 volts.

On the power distribution panel there are mounted six double-pole, quick-break lever switches, each suitable for a current of 300 amperes, and six double-pole fuses at the back of the board.

The lighting panel is equipped with a double-pole, quick-break lever switch for a current of 150 amperes, an automatic overload and reverse current circuit-breaker for 150 amperes, a voltmeter to read to 300 volts, and an amperemeter to read to 150 amperes. There is also the necessary distributing switches for the arc and incandescent lighting circuits.

The main cables are provided for conveying the current from the dynamo terminals to the main switchboard; these are lead-covered, and consist of six lengths of cable, composed of thirty-seven wires, No. 12 S. W. G. In addition there are the cables from the auxiliary dynamo to the



ELECTRIC MOTOR-DRIVEN ROLLS AT DIFFERDINGEN, GERMANY.

switchboard. The whole of these cables are lead-covered and laid in brick culverts.

From the main switchboard to the outside of the power-house the current is conveyed by lead-covered cables to a terminal gantry, from which the overhead cables are run, and the installation is divided into six circuits. The overhead cables are of bare copper, run on insulators, and terminate in distributing switchboards placed at various parts of the mill.

The whole of the cables in the mill are lead-covered, the lead-sheathing forming strong mechanical protection, as well as making the cables perfectly water-tight; they are run in earthenware pipes, or cleated to the wall, and covered with galvanized iron plates where found necessary. Separate circuits are run from the distributing boards to each motor and crane, so that there are no joints of any kind in the cables. The whole of the ten motors for the rolling mill are controlled from the two platforms, each platform having its own distributing board.

The casting pit crane of twenty-five tons capacity is of Scott & Mountain's three-motor type. Its span is forty-six feet six inches, and its lifting speed, full load, is six feet per minute.

The lifting speed at half load is twelve feet per minute, and the lifting speed at light load is thirty feet. This crane has a cross transverse speed at full load of sixty feet, and at light load 100 feet. Its longitudinal travel speed at full load is 120 feet, and at light load it is 180 feet. The crane is fitted with three motors, one for each motion. The lifting motor is of eighteen horse-power, working up to twenty-seven horse-power at 500 revolutions per minute; and the transverse motor develops eight horse-power, working up to twelve horse-power at 500 revolutions per minute; while the traveling motor is of twelve horse-power capacity. The main girders of the crane are of the fish-belly type, the crabs are made with steel sides with adjustable bearings, and the electric motors (which are of the totally enclosed type) are mounted two on the crab and one on the main girders. The starting, stopping and reversing motions of the crane are worked by liquid controllers.

The rolling-mill crane of twenty-five tons capacity is an exact counterpart of the casting pit crane, all parts being interchangeable; the span in this case, however, is about forty feet. The speeds of lift, transverse and travel and the power of the motors are exactly the same as mentioned above.

Of the two cranes over the reheating furnaces or soaking-pits, one crane has a lifting capacity of ten tons and the other five tons. The lifting speed of the cranes at full load is ten feet per minute, and at half load fifteen feet per minute, while at light load it is twenty feet. The cross transverse speed at full load is fifty feet, and at light load 100 feet. These cranes have a longitudinal travel speed at full load of 150 feet, and at light load it is 250 feet.

The lifting motor has a capacity of eight horse-power working up to twelve horse-power at 500 revolutions per minute, while the cross transverse motor is of five horse-power up to seven and one-half at 500 revolutions per minute, and the longitudinal travel motor eight horse-power up to twelve horse-power at 500 revolutions per minute. The lifting speed of the five-ton crane at full load is eight feet per minute, and at half load twelve feet, while at light load it is eighteen feet. The cross transverse speed at full load is seventy-five feet, and at light load 150 feet, while the longitudinal travel speed at full load is 150 feet, and at light load 250 to 300 feet.

This crane is fitted with three enclosed type motors. The lifting motor has a capacity of four horse-power to work up to six horse-power at 500 revolutions per minute, and the cross transverse motor four horse-power up to six horse-power at 500 revolutions per minute, while the longitudinal travel motor has a capacity of four horse-power working up to six horse-power at 500 revolutions per minute.

The hot saw is driven by a Scott & Mountain six-pole motor. It has an effective power at normal working of 100 horse-power, and the maximum output is 120 horse-power, while the speed is 470 revolutions per minute. The motor is fitted with extended bedplate, the pulley shaft being supported by the two outer bearings, enabling the armature to be removed, if required, without disturbing the driving-belt. The armature is coupled to the pulley shaft by solid forged coupling and turned bolts.

The two Thwaites blowers for supplying air to the three cupolas are driven by two continuous-current shunt-wound motors. The effective power of each motor is fifty-two horse-power, and its speed is 700 revolutions per minute. One motor is capable of driving the two blowers, so that practically one of the motors is a standby in case of an accident.

The engineers' shop and the roll-turning lathes are driven by two twenty-horse-power motors. The motors run at a speed of 880 revolutions per minute, and are each fitted with automatic starting switch and sliding bedplate.

The shears, which were made by Messrs. Craig & Donald, are driven by a twenty-horse-power motor running at a speed of 800 revolutions per minute; this motor is mounted on the shears and drives by means of a machine-cut steel pinion and cast-iron, machine-cut spur-wheel, direct on to the main shaft. The whole is self-contained, and the motor is stopped and started by means of a liquid starting switch with screw and hand-wheel. The design of motor adopted on the shears is the same as is used for the roll lathes and engineers' shop, and is of the totally enclosed type.

The straightening machine, which was made by Messrs. Craig & Donald, is driven by a twenty-horse-power motor running at 650 revolutions per minute, and also by a three-horse-power motor running at 1,000 revolutions per minute; these motors driving the machine direct through machine-cut gear.

The dolomite mill, which is of the pan type, together with the friction hoist for elevating the ground dolomite to the furnace floor, is driven by an electric motor of twenty effective horse-power running at 800 revolutions per minute.

The cold saw is driven by an electric motor of ten effective horse-power running at a speed of 1,000 revolutions per minute.

For operating the live roller gear seven motors of twenty to thirty horse-power, at 500 revolutions per minute, are used, and five motors of the same power are also used for working the pullover gear, saw roller rack, and hot bank pullover gear—*i. e.*, a total of twelve motors in all. These motors are all of the enclosed, series-wound type, and each motor has a reduction gear, so that the speed of the motor is reduced from 500 revolutions per minute on the motor shaft to fifty-five revolutions per minute on the line shaft of the various machines.

The motor shaft is fitted with a half coupling, which drives on to a pinion shaft running in two self-oiling bearings. On this shaft a forged steel machine-cut pinion is keyed, driving into a machine-cut, cast-iron spur-wheel on the second motion shaft, which also runs in two bearings. On this shaft a forged steel machine-cut pinion is fitted, driving into an idle-wheel, gun-metal bushel, which again drives into a forged steel machine-cut pinion on the line shaft. This gearing is arranged throughout for continuous lubrication, and suitable wrought-iron covers are fitted, the machines themselves

being placed underneath the mill floor plates.

The twelve motors are controlled from platforms in the mill in convenient positions. The controllers enable the motors to be stopped, started, reversed, and run at any desired speed; all metallic contacts are avoided, and consequent burning.

Two twenty-horse-power, series-wound, totally enclosed motors are used for screwing down the rolls. These motors run at a speed of about 1,000 revolutions per minute, and drive through machine-cut spur gearing on to a shaft across the two housings, the motors being mounted on the top of the housings. The horizontal shaft raises and lowers the screw by means of worms and worm-wheels.

The motor on this machine is of the enclosed type of twelve horse-power capacity, and drives the small drum through machine-cut spur gearing. The whole drum and motor are mounted upon a combination cast-iron frame fitted with brake and clutch. The gear is very compact, and will lift five tons direct from the barrel at a speed of ten feet per minute.

The offices and engine rooms are lighted by 106 sixteen-candle-power incandescent lamps.

ELECTRICAL NOTES FROM GREAT BRITAIN.

(By Our Special Correspondent.)

The enquiry by the joint committee of the two houses of Parliament into the question of municipal trading has been a very unsatisfactory affair. To begin with, the appointment of the committee did not take place until somewhere about Whitsuntide, and in order to make a report before Parliament rose for the session, it had to curtail the evidence put before it to one item of this very complex question, *viz.*, the methods of making up and auditing municipal accounts. This undoubtedly has an importance of its own, but there are numerous other questions involving a far wider sphere of influence upon municipal trading, such as the repayment of loans and a host of others which many of the municipalities were expecting to give evidece upon which have been left in the same state as they have been for many years past. Thus no general law is provided, and it is left to individual parliamentary committees to decide what shall be in different cases. These committees being of such a temporary nature as they are, often give directly opposite opinions upon precisely the same matters in different years, and thus no continuity of purpose or standardization of principle is possible. Another matter upon which some definite expression of opinion is required, is as to the period of loans to municipalities, which at present vary considerably, and no one seems satisfied with. It is left to the Local Government Board to fix the period, but the basis upon which they are granted no one seems to know. An exhaustive enquiry into the problem bound up with the words municipal trading would take a considerable time, but the present piecemeal method of dealing with the matter will never lead to any result whatever.

The parliamentary session just closed has not been remarkable either for the quality or quantity of its electrical legislation. It started off by causing the promoters of all the tube railway bills in London to abandon their propositions, as the government appointed the Royal Commission on London traffic after the session began, and made it clearly understood that no such bills as tube bills would be passed until the commission reported, which will not be in the immediate future. Probably the main feature has been the comparative success of the gas companies in securing in a number of electric lighting and tramway bills a provision that if after the end of a certain period the revenue did not balance the expenditure upon the undertaking, the charges were to be increased to allow of this. This period was fixed in a few cases at one year and in others at three years. If this year's proceedings are acted upon as a precedent, it will deter a large number of local authorities going into the electric supply business; as it is admittedly almost impossible to make a municipal undertaking of this character profitable during the first few years. The gas companies argued that they were ratepayers in the district, and that they ought not be made to help meet any deficiency upon an undertaking which was a competitor with itself. Beyond this, nothing of exceptional importance has happened. A system of trolley omnibuses was sanctioned to a company which purposes to construct tramways in Gloucestershire, but which wishes to make use of the cheaper mode for some thinly populated districts until they are more developed. A little excitement was also occasioned when a House of Lords committee—which was afterward backed up by a House of Commons committee—refused to exclude certain large towns already owning electricity works from the areas of two new large power distribution companies, thus placing the corporations, for the first time, under competition. Certain conditions are attached to this competition, and in my opinion the ratepayers will benefit, as the fear of such a competition will keep the municipal undertakings to the highest possible pitch of perfection.

The Institution of Electrical Engineers has made an important step toward securing a home for its meetings. At present all its meetings are held in the building of the Institution of Civil Engineers, and are likely to be so for some time. But the Institution has bought some property in Westminster, London, which is regarded as a very valuable site for a building, and the rents from this property are said to bring in as much, and possibly more, than the investments which have been realized for the purpose of the purchase. The Institution has a building fund of over $50,000, but this has not been called upon at present, and some $80,000 worth of ordinary investments has been made use of.

The scheme of higher technical education put forward by Lord Rosebery on behalf of some South African financiers as a means of more effectually dealing with German and other foreign competition has met with the approval of the London County Council, as the technical education authority for London. The idea is to found a college where higher research may be carried out by those without the means to pay for it, and for this purpose a large sum of money has been offered, together with a free site. It is estimated that the college will cost $100,000 per year for upkeep, and the London County Council is willing to contribute to this sum and to have two representatives on the board of control. Nothing further has yet been done in the matter.

It is stated that the Treasurer of the Australian Commonwealth has been notified to the effect that the partners in the Pacific cable will, in all probability, have to face a loss of over $1,000,000 by March, 1904. The loss during 1902 to 1903 was $600,000. The actual expenditure on the cable to March 31, 1903, was over $450,000; the share due from the contributing colonies being $625,500. A. W.

London, August 15.

Pure metallic zinc will last indefinitely in the atmosphere. Soon after exposure it becomes coated with a film of zinc oxide, which protects it from further oxidation. Its use has been suggested in the construction of monuments and other structures, for which purpose it would be more enduring than marble.

THE DIESEL ENGINE.[1]

BY H. ADE CLARK.

The author first discussed the theory of the Diesel engine and showed how the theoretical indicator card had been modified to comply with practical requirements (plate 1).

The actual Diesel engine has the following cycle of operations:

First stroke takes in air alone at atmospheric pressure and temperature.

Second stroke compresses this air to a high pressure (55 atmospheres = 500 pounds per square inch) and to a temperature of about 1,000 degrees Fahrenheit. This compression is neither isothermal nor adiabatic, since the operations are conducted in a water-jacketed conducting cylinder.

Third stroke is the working stroke, during the first part of which the combustion of the fuel is carried on at constant pressure for a period which is determined by the amount of oil to be sprayed in, which quantity is controlled by the governor. The second part of this stroke is approximately an adiabatic expansion.

Fourth stroke exhausts the gases.

EIGHTY-BRAKE-HORSE-POWER ENGINE.

This size of engine is made by the Vereinigte Machinenfabrik, Augsburg, and Carels Frères, Ghent. On plate 2 is illustrated a longitudinal section and a transverse section of the engine, with standard arrangements of piping for petroleum, lubricating oil, cooling water, air-blast, starting air and exhaust, in fact all the engine connections, except the water-cooling tanks when such are used.

Description—The engine is of the vertical type, with a strong cast-iron A frame, the upper part of which forms the outer wall of the water-jacket; into this upper part is fitted a cylinder of special close-grained cast-iron. The cylinder cover is deep and hollow, being thoroughly water-jacketed; in the transverse section will be seen two valves, the central one is the oil-sprayer, the other is the starting-valve, which may be made to act as the suction-valve for the air-pump. In the longitudinal section three valves are seen in the covers; in the centre is the oil-sprayer, on the right is the air-inlet, and on the left is the exhaust-valve. The oil-spraying valve opens upward or outward, and the others open downward or inward; all three are spring closed, the air and exhaust-valves being kept closed by pressure inside the cylinder. All valves are open by the action of the bent rocking-levers seen upon the right in the transverse section; the movements of the levers are determined by the cams placed upon the horizontal cam-shaft. The cam-shaft is driven at half the speed of the crank-shaft by means of the bevel gearing and the vertical shaft seen on the right in the longitudinal section.

The governor is of the loaded centrifugal type, and is placed at the top of the vertical shaft; its action is explained in connection with the oil-pump.

The piston is of the usual open trunk type, directly connected to a connecting-rod of the marine type. There are seven piston-rings of the Ramsbottom type, six near the top and one much lower, in order that it may pass the lubricating channels.

The crank-shaft is solid, and has three bearings fitted with ring lubricators. The flywheel is built in halves, and on the inner edge of the rim is a toothed ring into which work two ratchet-pawls, actuated by a rocking-lever; this device is for bringing the engine into the starting position, that is, with the crank just beyond its top dead-centre.

On the left of the longitudinal section, Fig. 3, plate 2, is the petroleum pump. This pump is connected by a pipe to the petroleum-filtering tanks, and by a pipe of small bore to the oil-spraying valve. The plunger of this pump is driven by a crank-pin placed in a disc at the end of the cam-shaft, and also has a constant stroke.

On the right of the transverse section, Fig. 4, is the air-pump; its cylinder is thoroughly water-jacketed, and the plunger is driven by connecting-rod, rocking-levers and connecting links from the small end of the connecting-rod. This pump takes its air from the engine cylinder just before the end of the compression stroke, still further compresses this air, and delivers it to the air-blast reservoir. In the earlier designs the pump took its air direct from the atmosphere, and was then much more bulky and less efficient.

The air-blast reservoir is the smaller one on the right of the cross-section, and is connected to the oil-spraying valve for injecting the petroleum into the cylinder against the high pressure of thirty-five atmospheres already existing there; for this purpose the pump maintains a steady pressure in the reservoir of five to fifteen atmospheres higher, that is from forty to fifty-five atmospheres. It is also connected by an overflow valve to the air-starting reservoir, this valve allowing air to pass from the blast to the reservoir when the pressure in the former exceeds a predetermined value. There may be a similar overflow valve connecting the engine cylinder to the starting reservoir, in order that the maximum compression pressure may be controlled.

The cylinder lubrication is forced by means of the pumps seen on the left of the engine in the longitudinal section, the lubricant entering at five or six points in a horizontal plane, below which one piston-ring passes. The crank is lubricated by the ring and oil ways seen in the longitudinal section. The lubricant is forced to the small end of the rod inside the piston.

The water-jacket is very complete, as the sections show, entirely enveloping the engine cylinder walls and end, and also the air-pump. The water enters at the bottom of the engine jacket, and passes upward through this jacket and the air-pump jacket, from the top to the cylinder cover, the outlet being close to the exhaust pipe.

The oil-spraying or pulverizing valve is illustrated in Fig. 3, plate 2. The horizontal section shows the petroleum and air-blast passages to the central valve, and the vertical section shows the body of cast iron, with the petroleum passage and overflow or test valve, the cen-

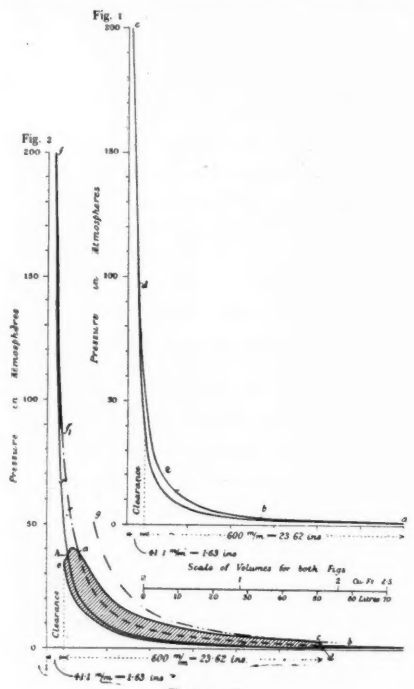


PLATE 1.

Fig. 1.—Theoretical Cycle for Diesel Engine, drawn for the Cylinder of 80-B.H.P. Engine.

a-b Isothermal Compression.
b-c Adiabatic Compression.
c-d Isothermal Combustion.
d-e-a Adiabatic Expansion.

Fig. 2.—Comparison of the Indicator Card *d-e-h-a-c* with the modified cycle.

d-h-f Adiabatic Compression.
f-f1-a Isothermal Combustion.
a-b Adiabatic Expansion (broken line.)

[1] Abstract of paper read at the recent meeting of the British Institution of Mechanical Engineers, Leeds, July.

tral needle valve with its guiding sheath and at the base the pulverizing device, consisting of a set of four metal rings of special form perforated by small holes and separated by four metal bands; the terminating nose piece has narrow channels cut in it, through which the pulverized oil passes to the expanding orifice, and is sprayed into the cylinder when the needle valve is raised. It will be seen that the petroleum pump delivers petroleum to the nozzle by the narrow passage, and that the nozzle is in direct communication with the air-blast reservoir, the pressure in which is kept steadily about 150 pounds higher than the maximum pressure of compression. This device works well.

The petroleum pump is shown in Fig. 3, plate 2. The plunger has a constant stroke, being driven from the end of the valve cam-shaft. Passing through the head of the plunger is a lever working upon an eccentric fulcrum; to this lever is attached the valve-rod which opens the inlet valve against the action of a spring. The fulcrum of the rocking-lever is eccentric to the shaft upon which it is placed, and this shaft is caused to rotate by the action of the governor, thus altering the stroke of the valve-rod and through it the opening of the inlet valve, thus controlling the amount of oil passing to the pump chamber to be forced past the outlet valve to the injecting valve.

There is a controlling device shown, by which the inlet valve can be held open, thus allowing the plunger to pump back the oil to the pump reservoir tank instead of passing it on to the engine by way of the outlet valve. The tappet of this device encircles the valve-rod foot tappet.

Starting and Running of the Engine—The engine is started by compressed air, which is stored in the starting reservoir under a pressure of about fifty-five atmospheres or 800 pounds per square inch, by the air-pump during the previous run of the engine, or, in the case of a new engine, the makers send out these reservoirs ready charged; there is little or no danger of these vessels losing a charge. An engine of this type at the Sewerage Farm at Harrogate was started by air stored at Augsburg eight weeks previously, and in the case of an engine sent to India the vessels were charged four months before the engine was started from them.

On Fig. 5 three pairs of curves are shown, one pair for each of the engines tested by the author, the lower curves (straight lines) show the oil-consumption of these engines as the load varied. These curves of total consumption show well the action of the governor in cutting down the oil-supply to the requirements of the engine, a result not so nearly approached by other types of oil engine; the curves show that the oil-supply is directly proportional to the horse-power, except at very low loads, that is, loads below twenty-five per cent of the normal. In the thirty-five-horse-power engine the total oil-consumption is fairly well given by the equation:

Total oil in pounds per hour = 4 + 0.357 × brake-horse-power for powers over ten brake-horse-power.

In the eighty-brake-horse-power engine the equation is:

Total oil in pounds per hour = 7.5 + 0.336 × brake-horse-power.

In the case of the 160-brake-horse-power engine the equation becomes:

Total oil per hour = 10 + 0.345 × brake-horse-power, for brake-horse-powers larger than fifty when both cylinders are at work.

The upper three curves show the oil-consumption per brake-horse-power-hour; it will be observed that those curves descend to nearly the same value at top loads, and that the rate of increase of consumption is not high, even down to half load; both facts which point to the economy of this engine when distributed in small units, making it unnecessary to concentrate the power in large units and then use expensive transmission to the points where the power is required.

The performance of the 160-brake-horse-power engine under variation of load was as follows:

Load on the dynamo 700 amperes at 115 volts, that is, 108 horse-power, tachometer reading eighty-nine.

The whole load thrown off at once, the tachometer ran up to 96.2 and settled back to 88.7 in about a minute.

The engine running light, tachometer

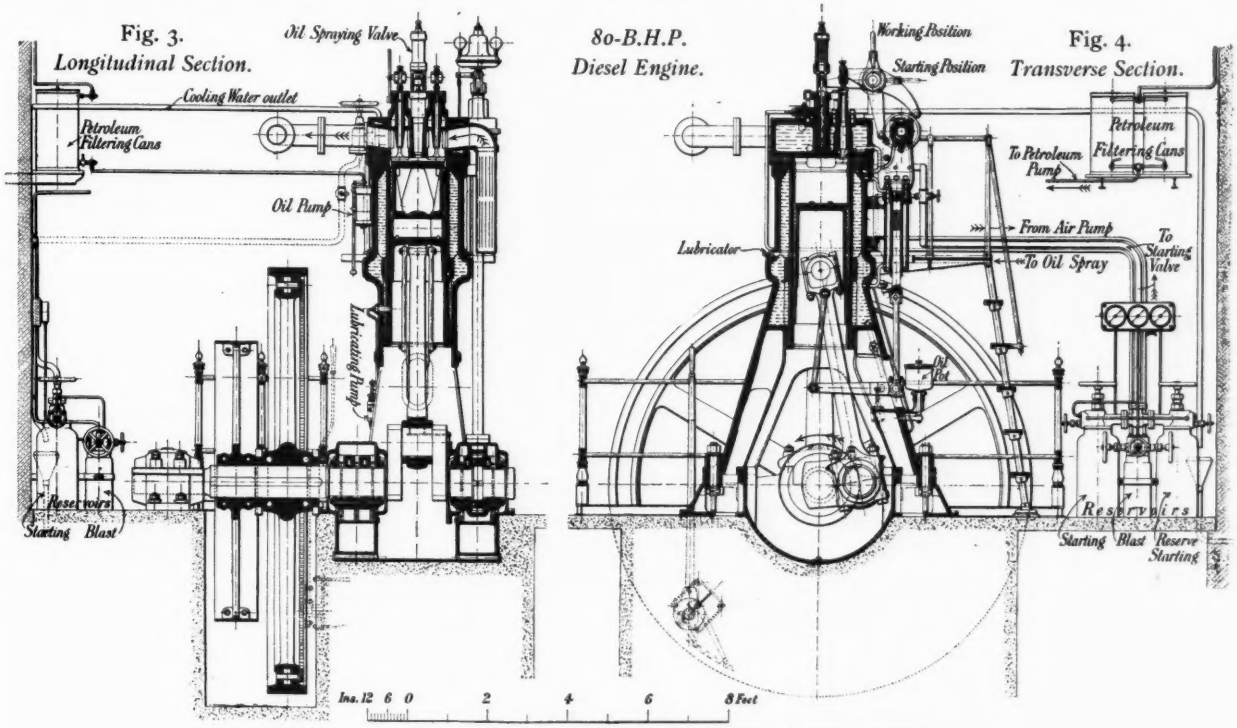


PLATE 2.—LONGITUDINAL AND TRANSVERSE SECTION, DIESEL ENGINE.

ninety-one, a load of 700 amperes at 115 volts was put on at once, when the lowest reading of the tachometer was 87.8 and the engine settled back to ninety in about half-a-minute.

THE FOLLOWING TABLE GIVES THE RESULTS OF A TEST ON AN EIGHTY-BRAKE-HORSE-POWER DIESEL ENGINE MADE BY THE AUTHOR.

Tests of single-cylinder Diesel engine at Carels Frères, Ghent, on February 7, 1903.

This trial was run in response to the request of A. J. Lawson, engineer to the British Electric Traction Company, H. W. Anderson, London, and the author, when on a visit of inspection to Messrs. Carels Frères' works at Ghent. Preparations for running this trial not having been made, it is not so complete as the others.

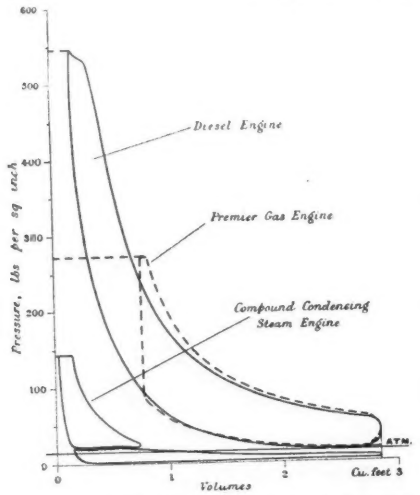


FIG. 6. — COMPARISON OF THE PRESSURES, POWERS, AND CLEARANCES OF STEAM, GAS AND OIL ENGINES.

The indicator cards are drawn to the same scale and for the same total volume of cylinder.
I.H.P. at 160 revolutions per minute.
Diesel Engine = 105. Gas Engine = 66.
Steam Engine 24 × 4 = 96.
(Reduced ½d smaller than original diagram.)

The transmission to the dynamo consisted of a belt to a line shaft and a belt from the shaft to the dynamo; there was also belted to the shaft a motor which was running light.

In Fig. 6 is shown a comparison of the pressures, powers and clearances of the three types of engine, namely, the compound condensing engine using high-pressure steam with jacketed cylinders, the scavenging type of gas engine using gas of 600 British thermal unit per cubic foot, and the Diesel engine using crude petroleum. The indicator cards there shown are drawn to the same scales and for the same total volume of cylinder.

In the following table a comparative and fairly accurate statement of costs is drawn up for three sizes of engine, namely, 35, 80 and 160 brake-horse-power. The estimate includes interest on plants and buildings, maintenance depreciation, fuel and water.

The gas engine taken for comparison is the Crossley using a Dowson gas-producer. The steam engine compared with is the high-speed compound condensing engine.

The fuels are: For the Diesel, crude petroleum at 45s. per ton. For the gas-producer, anthracite cobbles at 24s. per ton. For the steam engine, coal at 12s. 6d. per ton. In all cases delivered.

The oil-consumption for the Diesel has been taken, in each case, as the mean between the full and half-power rates of consumption.

Summary of Results.

1. Load	0.25	0.5	0.75	Full
2. Duration in minutes	30.5	30.1	32	30.75
3. Total revolutions	4,880	4,863	4,800	4,797
4. Revolutions per minute	163	161	160	160
5. Mean effective pressures	48.5	68.4	89.1	109.4
6. Indicated horse-power	46.8	67.0	82.8	101.5
7. Effective horse-power	24 8	45	60.8	79.5
8. Electrical horse-power	17.3	35 6	52.1	68.8
9. Mechanical efficiency	53	67.0	73.5	78.3
10. Total oil in pounds	8.38	10.73	Lost	17.63
11. Oil per I. H. P. hour	0.352	0.320	.....	0.339
12. Oil per effective H. P. hour	0,664	0.477	.....	0.434
13. Oil per electrical H. P. hour	0.952	0.601	.....	0.500
14. B. Th. U.'s per I. H. P. minute	114	104	.....	111
15. Thermal efficiency on the I. H. P., per cent	37.2	40.8	.....	39.9
16. Thermal efficiency on the B. H P., per cent	19.7	27.3	.....	31.2

The fuel-consumption in the case of the gas-producer has been taken at 1.5 to 1.25 pounds per brake-horse-power-hour plus an allowance for stand-by losses.

The fuel-consumption for the steam engine has been taken at four pounds and 3.5 pounds per brake-horse-power for the lowest and highest powers; assuming an evaporation of eight pounds of water per pound of fuel.

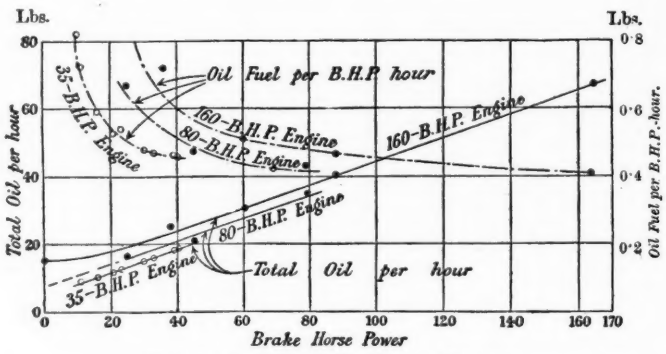


FIG. 5.—OIL FUEL FOR DIESEL ENGINE.

The final result is as follows:

Total Cost Per Brake-Horse-Power-Hour.

Engines.	Diesel. Penny.	Gas. Penny.	Steam Penny.
35 B. H. P.	0.59	0.69	0.89
80 B. H. P.	0.39	0.52	0.63
160 B. H. P.	0.32	0.40	0.49

A result which is much in favor of the Diesel engine.

Announcement by the American Electrochemical Society.

The American Electrochemical Society announces that arrangements have been practically completed for supplying free to all members of the society the transactions of the London Faraday Society, the recently formed British electrochemical society. This will be accomplished by supplying the transactions of the American Electrochemical Society free to the members of the Faraday Society. There will be no increase in the dues of the former society on account of this arrangement.

Science Abstracts.

The council of the British Institution of Electrical Engineers has, with the approval of the Physical Society, undertaken the publication of *Science Abstracts* as an institution publication. Mr. Louis H. Walters has been appointed editorial assistant to the secretary and will take up his duties in the autumn. *Science Abstracts* is a monthly publication which gives abstracts of all scientific and technical papers of importance appearing in the scientific technical press. It is published in two sections, one devoted to physical science and the other to applied science, or engineering.

THE ELECTRICAL DRIVING OF WINDING GEARS.[1]

BY F. HIRD.

The application of electricity to the driving of winding gears forms one of the most recent and important developments in electrical mining work. The improvements, which have made electrical winding a serious rival to steam, are of quite recent date; nevertheless, many electrical winding gears have already been installed, and have been in satisfactory operation for several years. The earliest applications of electricity have, however, been confined to cases where fuel was costly and water power was available within a reasonable distance. The advantages of electricity as a means of efficiently transmitting power were sufficient in such cases to determine its adoption for driving the winding gears as well as the pumps and other machinery.

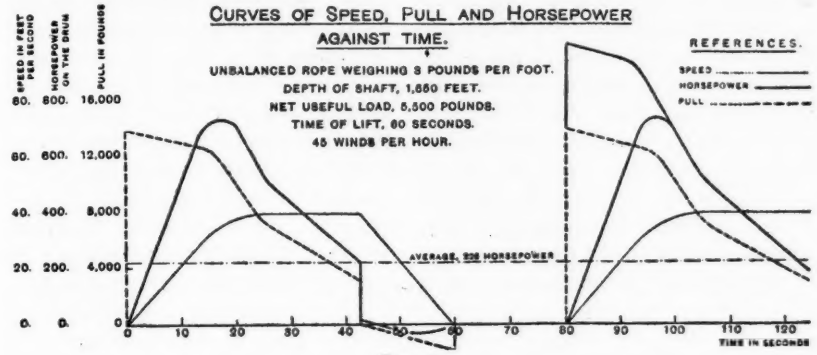


FIG. 1.

It will readily be understood that the chief problem for the electrician lies in finding the most suitable method of control. The motor itself is a well-tried machine, and presents no difficulty, but the controlling apparatus must be designed to meet the arduous conditions of frequent starting and stopping, must provide the greatest accuracy of control, and must permit of steady running at slow speeds for the purpose of repairs, inspection, etc., in the shaft. The usual method of starting an electric motor, by inserting a variable resistance in the circuit of its armature or rotor and gradually cutting it out as the speed rises, is objectionable in cases where the starts are numerous, on account of the heavy loss of energy in the resistance when starting. Messrs. Siemens & Halske, of Berlin, were, the writer believes, the first to devise an electric winding system which efficiently equalizes the power demanded by means of power storage. A winding engine built by the Bergwerksverein Friedrichs-Wilhelmshütte at Mülheim-on-the-Ruhr, and electrically equipped by Messrs. Siemens & Halske, of Berlin, on this system was shown at the Düsseldorf Exhibition of 1902. In this plant two motors are used which are directly coupled to the winding drum without use of intermediate gearing. A battery of electric accumulators furnishes the means of storing power during intervals of no load or of light load, and of assisting the generating station during the times of heaviest demand. During retardation at the end of a trip, the kinetic energy of the moving parts is paid back into the accumulators instead of being wasted in the brakes. The battery fulfils yet another function, namely, that of furnishing a series of voltages for effecting the speed control. It is divided into four groups, and the two motors are capable of being connected in series or parallel. The various electrical groupings thus rendered possible give a very satisfactory and efficient speed control. A rheostat is only used to smooth out the steps between successive groupings. The various electrical connections, which have to be made during each journey, necessitate the moving of heavy switching gear, and it is necessary that the correct connections for starting, stopping, paying back energy to the accumulators, and so on, should be effected safely and reliably without any thought or discretion on the part of the attendant. All this has been effected by means of a pneumatic system of control, and the compressed air is also utilized for operating the emergency brakes. The safety appliances are most complete and carefully thought out, and whatever complexity there may be in the switching arrangements is entirely dealt with by the mechanism, and leaves the actual handling unaffected. All the necessary operations are affected in the correct order by the motion of a single handle.

Mr. Ilgner, chief engineer of the Donnersmarkhütte, should be credited with the suggestion of providing for the necessary storage of energy by a suitable high-speed flywheel. The combination of this flywheel with a motor-generator, which furnishes the means of control, constitutes the essential feature of the Siemens-Ilgner system. The control is provided by a motor-generator which consists of the following parts: 1. A motor capable of furnishing the average power required by the winding gear. This motor may be a three-phase induction motor or a continuous-current motor according to circumstances. 2. A continuous-current generator, whose function is to provide the current for the winding-gear motor. This machine is arranged so that the excitation of its field is variable through wide limits, in fact, from its full maximum through zero to its maximum value in the opposite direction. By this means, the voltage or pressure of supply to the motor can be varied through the same range. 3. A small continuous-current machine, whose function is to provide the exciting current for the generator just mentioned, and also for the winding-gear motor. This special exciter is necessary, in order to ensure stability of the field and, therefore, of the pressure, which could not be attained through such a wide range, if the generator were allowed to

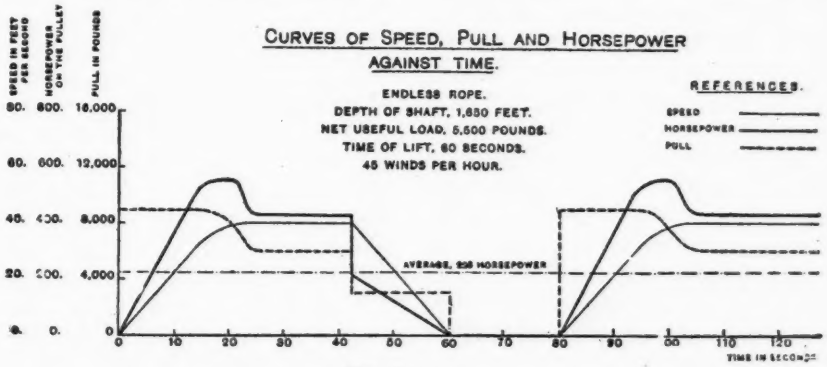


FIG. 2.

[1] Abstract of a paper read before the Institution of Mining Engineers, London.

furnish its own exciting current. And (4) a heavy steel flywheel, specially designed for high circumferential speeds, so as to store a large amount of energy in proportion to its weight. The current from the generator is taken straight to the armature of the motor, which drives the winding drum, without passing through any switches, fuses or controlling gear, for it is one of the special advantages of this system that no manipulation of the heavy main current is required, the whole of the control being effected by light switching gear dealing only with the small currents used for exciting the field magnets. The motor for actually driving the winding drum is of the continuous-current type. The drums may be driven through gearing, but for powers over 100 horse-power it is considered better practice to couple the motor directly to the drum without any intermediate gearing. The slow speed thus necessitated makes the motor somewhat larger and more expensive in the first place, but the disadvantages of gear for heavy powers, together with the noise and the wear and tear, which are inseparable from its use, more than set off the extra cost. The necessary control is effected by the motion of a single lever which is arranged to work in either of two slots provided in the supporting frame, one for each direction of motion. When the lever is drawn back to its extreme position, and there is, therefore, no current on, it can be passed from one slot to the other. The effect of this motion is to throw over a reversing switch, which controls the direction of the current in the field circuit of the generator. This determines the direction of the main current furnished to the winding motor, and, consequently, the direction of its rotation. The motion of the lever in either of the slots has the same effect; it gradually cuts out the resistance which is connected in the field circuit of the generator, which thus acquires a stronger field and, therefore, provides a proportionally greater electrical pressure to the winding motor. The excitation of the field of the motor, however, is kept constant and, since its speed is proportional to the pressure of its supply, the forward motion of the lever determines a corresponding increase in the speed of the winding motor. For each position of the controlling lever there is a definite speed of the winding motor; and this is quite stable and independent of the load and can have any desired value from nothing up to the maximum rate of speed.

Too rapid motion of the controlling lever is prevented by means of an adjustable oil dash-pot. A depth indicator is provided which consists of two vertical screws suitably geared to the drum, each having a traveling nut, representing one of the winding cages. These nuts are provided with curved steel fingers, which come into operation near the end of their travel and push back the control lever to a position which allows only of a greatly reduced speed. The attendant can then no longer increase the speed, but, as the lever is free to go further back, he has complete control as regards further slowing down or stopping. Should he, however, through any accident or negligence, miss stopping at the right moment, a second finger on the nut pushes the control lever into the off position and applies the emergency brakes. There are usually two sets of brakes provided, the working brakes and the emergency brakes. The former are applied by the action of a piston working in a cylinder to which compressed air can be admitted. The valve for admitting the compressed air is operated by a handle, placed conveniently near the controlling lever, and connected with it in such a manner that when it occupies the off position the brakes are applied, and they are released when it is moved to the starting position. It should be noted that normally the brakes are only used to hold the load, and that there is no absorption of power, any excess of energy in the moving system at the end of the journey being taken up electrically. Thus, when the winding cages are traveling at full speed, if the control handle be moved back nearly to the off position, the pressure of the generator is reduced below that which the winding motor can produce, the latter, therefore, works as a generator, pays back energy into the motor-generator, accelerates its speed and thus stores energy in its flywheel; and meanwhile it draws its generating power from the energy of the moving system and thus produces the necessary braking effect. After a little practice, the right moment for drawing back the control lever is ascertained and the winding cage is brought to rest at the right place without using the compressed air brake until the last moment. The emergency brakes are entirely distinct from the working brakes and are applied by means of a counterbalance weight, which is normally supported by the pressure of the compressed air on a piston, and by this means the brakes are held off the drums during working. The brakes are, therefore, applied if through any accident the air-pressure fails; they are also applied by a special trigger on the depth indicator should the cage overrun the bank as mentioned already, and they can also, in the case of emergency, be applied by hand. In any case, the fall of the weight is arranged to open a special emergency switch which entirely disconnects the winding motor. It will be seen that very ample provision has been made for security and to guard against misuse or negligence.

The writer will now consider, in a little more detail, the exact action of the flywheel on the motor-generator, as this forms an important feature of the system. In Figs. 1 and 2 the thick black lines represent the horse-power momentarily required on the drum or pulley. Fig. 1 represents the case of an unbalanced rope, and the fluctuations of horse-power are naturally much greater than in Fig. 2, where there is an endless rope passing over pulleys at the top and bottom of the shaft; the average horse-power, however, is the same in both cases. If we succeed, therefore, in completely equalizing the demand for power by means of flywheel storage, the demand for power will be the same in both cases; we shall, however, require a larger flywheel in the first than in the second case. Taking the first case, we find from consideration of the curve that the amount of stored energy available must be 9,000 horse-power-seconds, or 4,950,000 foot-pounds. To store so large an amount, the flywheel must be made entirely of steel, and run at a peripheral speed of about 16,000 feet per minute. Under these conditions, a fourteen-ton flywheel would give out 9,000 horse-power-seconds with a reduction of speed of about ten per cent. In practice, the flywheel would be made of a weight of about twenty tons, so as to allow for the inevitable loss of energy in the double conversion. The total amount of energy stored is, of course, much greater than the amount mentioned above, but it is only available by admitting of a greater reduction of speed than is advisable in normal working. Should, however, any accident occur, which involves the entire cutting off of the electric supply, the energy stored in the flywheel would all be available, allowing only for electrical losses. The net stored energy in such a flywheel is about 380 million foot-pounds, of which at least seventy-five per cent is available for effective work on the net useful load.

The useful work to be done in one lift is 5,500 pounds by 1,650 feet, or 90.75 million foot-pounds. Consequently, it will be recognized that there is enough energy stored for three lifts after the total cessation of the electric supply. At the beginning of a journey, the motor-generator may be assumed to be running at nearly its maximum speed. When the lift commences, the power is at first supplied entirely by the generating station, but as soon as the demand has become greater than the average, the motor-generator begins to slow down and its flywheel furnishes the excess of power required; as soon, however, as the demand for power has fallen again below the average, the motor-generator begins to speed up again, storing power once more in its flywheel. It continues to do so after the completion of the trip and before the next lift begins, drawing this power from the generating station and providing it with a load during the period of rest. If the plant is well proportioned for the conditions of the work, the motor-generator will have nearly reached its maximum speed when the next call for power comes upon it. Should an unusually short rest occur, it will not have reached so high a speed and will run somewhat slower for one or two trips, while, if an unusually long stop occur, it will reach its full speed before the next lift commences, and its demand on the generating station will begin to fall, so that the equalization of load will not be complete. In practice, however, with a fair margin in the flywheel, the equalization will usually be pretty complete, and if the generating station be used for other work, or if there are several electric winding engines at work, the actual fluctuations in the demand on the generating station will be practically negligible.

The steam consumption of winding engines varies through an enormous range according to the nature of the work, of the engine itself, and of the attention it receives; but, in any case, it is extremely high as compared with ordinary steam practice on fairly steady work. It is clear, therefore, that the conditions of steam winding are unfavorable for economy. The engine has to be capable of very great though short overloads, the load itself is extremely intermittent, and there are intervals of standing idle during which steam is being condensed in the pipes, and, very possibly, it is blowing off from the boilers in great quantities as well. Again, the engine must be capable of running in either direction and of starting from any position These conditions are in themselves unfavorable for economical valve-setting, but they have the still greater disadvantage that the steam distribution has to be largely under the control of the operator, and this in itself is a most prolific source of waste. A trial has recently been made on the large twin-tandem winding engine of the Rheinebe III colliery, the property of the Gelsenkirchen Mining Company. The trial extended over one shift of nine hours, and the consumption of steam was found to be 114 pounds per effective horse-power-hour. (All the steam consumptions given in this paper are per horse-power-hour on the net useful load lifted in the shaft.) During this trial the winding engine was handled in the usual manner by its ordinary attendant, and the conditions were those ordinarily obtaining. A second trial of nine hours was next taken, in which the only difference was that the operator was strictly supervised during the whole extent of the trial by an expert engineer. The result was a consumption of seventy pounds per effective horse-power-hour. These figures speak for themselves, but they have a special significance from our point of view, as will presently be seen. In the preceding trials, the steam exhausted into the atmosphere, and a further trial, under condensing conditions, with the same careful supervision, gave a steam consumption of fifty-seven pounds per effective horse-power-hour, Other searching trials, extending over long periods, have been made by Mr. Buschmann on the winding engine at the Heilbronn salt mines, and this engineer concludes that with such care and attention as can be realized in practice, seventy-seven pounds of steam per effective horse-power-hour can be attained, though with special supervision of the operator he reached so low a figure as sixty-eight pounds. We shall, however, err greatly if we suppose that such figures represent a fair average of what is taking place in the winding engines actually in operation. These results were obtained with modern engines of the best and most economic type, and care was taken that the engines should have full duty during the trial; but if we take into account the losses incident to times of slack lifting or of total cessation of work, a figure of about ninety-five pounds will be nearer the mark; while if we consider cases such as are unfortunately too common, where very low pressures, late cut off and generally obsolete and inefficient machinery and methods are in use, it is hard to say what extravagant figure may not be reached. We are now in a position to understand the full importance of an equalized load on the prime-mover. For it may be observed that the extravagant steam consumptions just given are almost entirely attributable to the intermittent nature of the work. On the other hand, given a fairly uniform load moving at a constant speed, and there is clearly nothing to prevent us availing ourselves of the best modern practice in the economical generation of power. In making a comparison with the tests just quoted, however, we will not assume the very highest attainable economy, but a moderate working figure. A fair average steam consumption for a modern generating plant under the conditions of daily work with moderately fluctuating loads, such as we may expect in this case, is twenty pounds of steam per electrical horse-power-hour, and this value will be taken as the basis of our comparison. Experience with existing electrical winding gears and a careful consideration of all the working conditions with the Siemens-Ilgner system leads one to expect a total efficiency of sixty per cent under daily working conditions. That is to say, of the total electrical energy supplied to the terminals of the motor-generator, sixty per cent appears as net work in raising the useful load in the shaft. To be on the safe side, however, an efficiency of only fifty per cent will be taken, from which we deduce a steam consumption of forty pounds of steam per effective horse-power-hour on the useful load, a great deal less than the best result with steam, and less than half what may be regarded as an average working result with steam winding. No negligence or mishandling on the part of the operator can appreciably affect this figure. The steam distribution in the engine cylinders is entirely out of his control and the chief cause of waste is thus removed. Practically, the only harm that he can do is to make a bad stop with an undue amount of braking, but even this has little effect on the economy, for with this system the energy of the moving parts is not wasted in friction but stored in the flywheel and at least seventy-five per cent of it may be recovered. It is, in the writer's opinion, one of the chief advantages of the system that it removes from the attendant the dangerous power of controlling the steam consumption. It is, of course, advisable in this, as in any system, that attention should be paid to the correct operation of the winding engine, for only in this way can rapid and uniform handling of the output be attained, but any lack of care is not attend-

ed with the direct and disastrous losses which occur in steam plant.

The writer must not close this paper without briefly referring to the subject of the first cost involved in electrical plant. Naturally, it is not possible to say anything very definite on this point, since it greatly depends upon the particular circumstances of each case; but, broadly speaking, one may say that the cost of an electrical winding plant, with motor-generator and all safety and controlling devices complete, would be about the same as that of a good modern steam winding plant of the same capacity. We have, of course, to consider the means of generating the electricity in addition. The cost of this will depend greatly upon circumstances, but it will not usually be a heavy item. In most cases a generating station would be erected for other work besides winding, and the average power only has to be supplied. In such cases the fair share of the cost attributable to the winding gear would probably not exceed the sum saved in boilers, stokers and steam pipes, which would be dispensed with owing to the smaller steam consumption.

International Conference on Wireless Telegraphy.

The countries represented at the International Conference of Wireless Telegraphy were the following: Italy, Germany, England, France, Austria, Russia, Hungary and the United States. Each country sent representatives to the number of forty-four, belonging particularly to the administration of Posts and Telegraphs of the countries mentioned.

As is known, the conference had for its purpose to prepare solutions of the problems raised by wireless telegraphy between the different countries, but without that its deliberations had a definite character.

The first meeting took place in the Assembly Hall of the Bureau of Imperial Posts, Berlin, Germany, and was opened by M. Krätka, who welcomed the members in the name of his government. It was decided to keep the deliberations of the commission rigorously secret.

One notice connected with the conference is that of the experiments of Professor Slaby on wireless telegraphy, which he is conducting now at Berlin. To continue his researches on wireless telegraphy he has received a subsidy of 25,000 francs from the "Jubilee Funds of the German Industrie." Now, on the occasion of the above-mentioned conference, Professor Slaby presented to the commission a preliminary report on the results obtained.

Up to the present, the part played by the earth in wireless telegraphy was an unsettled question. By creating a kind of artificial earth by means of an extended structure of zinc, the author had been able to detect the presence of stationary waves, putting in evidence a remarkable concourse of the earth in phenomena for this purpose.

The theory of closed transmitters has not been able to explain the effects at a distance and Professor Slaby established a new theory, explaining them by harmonics.

The most important part of the present researches was given the construction of apparatus for easy manipulation. More than twelve types for this purpose being described. E. BIGNAMI.

Berlin, August 22.

PNEUMATIC AND ELECTRIC LOCOMOTIVES IN AND ABOUT COAL MINES.[1]

BY A. S. E. ACKERMANN.

The seams worked in America are much thicker and nearer the surface than in Britain, and the dip is very much less, five per cent being about the maximum, while faults are almost unknown. The roofs are usually good, fire damp is rare, and a large percentage of the mines are drift ones. In this country electrical energy is transmitted to the pit bottom where it is used for driving one of the rope-haulage systems, but in America the twenty-one cases that the author saw were on the overhead-trolley system and were worked with locomotives. Pneumatic locomotives are much more cumbersome than electric locomotives, owing to the two large steel compressed-air vessels which they carry, and hence they can only be used on the main haulage lines and where there are no sharp curves. The usual arrangement is to have electric haulage even where cutting is done by pneumatic machines.

The electric trolley wire is very simply fixed from the roof where it is good, or from the cross-timbers where it is bad, and the rail is used for the return, though, in the case of coal-cutters, there are usually two bare wires, both supported from one set of brackets fixed to the roof and with the earthed wire on the outside, so that it slightly protects the positive or live wire. It has been said that a man can lay a greater length of electric cable in a day than he can pipes in a week. The cost of the electric locomotive compares favorably with that of the pneumatic. In upkeep the electric system also has the advantage, and the efficiency of electrical transmission of energy is considerably higher than that by air. The weight of the rails is usually forty pounds per yard, but in nearly every mine they wished they had heavier metals, whatever their actual ones happened to be. The mines are systematically worked on the pillar-and-room system, electric trolley haulage is used on the headings, and the men who load the tubs in the rooms push them to the entries where they are picked up by the electric locomotives.

Electric locomotives are much smaller than the pneumatic ones of the same weight; the overall dimensions of a thirteen-ton electric locomotive being about three feet in height, four feet eight inches in width and twelve feet six inches in length, with a wheel-base four feet eight inches in length, gauge three feet six inches (the gauges vary in different mines, but three feet six inches may be taken as the average) and capable of exerting a draw-bar pull of 4,300 pounds. Much smaller electric locomotives can, however, be obtained, as for example, one which is only two feet five inches in height, three feet six inches in width and nine feet three inches in length, with a wheel-base three feet in length, weighing four tons, and having a draw-bar pull of 1,000 pounds. This is, of course, a great advantage, and they run at about the same speed—namely, about eight miles per hour. At first there used to be considerable trouble on account of the armatures being burnt, owing to overloading and the heavy starting current. Now, even an eleven-ton electric locomotive is fitted with two forty-horse-power motors, one on each axle.

In drift mines the external part of the system is like a small overhead trolley-tram system, the conductor being attached to cross-wires supported by two rough wooden poles, one on either side of the line. The trolley wire in such cases is usually, but not always, kept at such a height as just to clear one's head. Electric storage battery locomotives have also been made, but the author did not meet with any; 250 and 500 volts were the only pressures met with, and all were continuous current, though in one mine three-phase current was used for working the pumps. The tendency in America is undoubtedly to use electric locomotives and coal-cutters more and more. In the Windber mines, seven power-houses have a total capacity of 2,500 kilowatts. There are seventy-five miles of trolley line, worked by forty-three thirteen-ton electric locomotives of which the combined power is about 3,400 horse-power; the output from one mine is 2,000 tons per day, and the others have about the same output each. In addition to rope haulage they had eight mules and eight drivers costing £4 per day for an output of 200 tons, that is sixpence per ton. When two thirteen-ton electric locomotives were installed the output increased by 1,000 tons per day at a cost for haulage of £1 12s.—or less than one halfpenny per ton.

[1] Abstract of a paper read before the Institution of Mining Engineers, London.

Surface Contact Systems on the Paris Traction Lines.

By C. L. Durand.

PARIS contains a great variety of electric traction systems, owing to the fact that the trolley is not generally allowed within the city limits. The lines which pass through the city and thence to the suburbs are obliged to adopt a method of traction within the city limits which will avoid the use of the trolley, and as the lines are owned by many different companies, each choosing its own method, nearly all the existing systems have been given a trial. A great number of lines use the accumulator system within the city and also in the suburbs. One line has an accumulator locomotive which is switched off at the city gates and the car continues over a trolley line. The underground conduit is now working very successfully upon a large system of lines, while the surface contact is also proving a favorite. Two of the leading surface contact systems will be here described. Both of them have been given a thorough test during a number of years.

The Diatto system of surface contact is now in use on a number of important lines which pass from the city to the suburbs in different directions, using the surface contact inside the city and the trolley for the suburban lines. The different lines on the west bank of the Seine

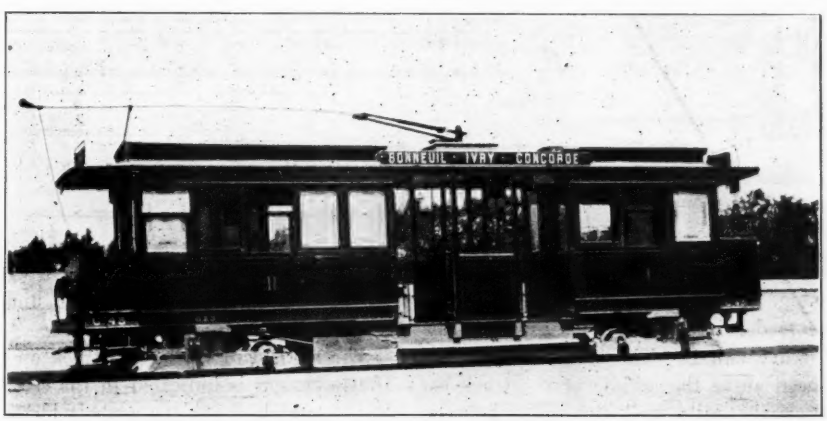


FIG. 1.—CAR ON DIATTO SYSTEM, PARIS, FRANCE.

are supplied from the large Moulineaux station which has been recently described. The three-phase current at 5,000 volts is transformed to 550 volts, direct current, by a series of substations which supply each road. Fig. 1 shows the standard type of car which is used on all the Diatto lines in Paris. The first and second-class compartments are separated by a large central platform. These cars carry forty-eight passengers in all, and use two Westinghouse motors of thirty-five horse-power each. The Diatto system uses a number of circular contact blocks, which are laid between the rails. A long contact-bar carried under the car passes over the blocks and brings the current to the motors. The mechanism for distributing the current from the underground feeder to each block as the car passes is contained within the block itself. It consists essentially of an iron plunger which is raised by the magnetized bar carried on the car, and thus completes the circuit for the block.

The working of the Diatto contact block will be observed in the accompanying diagram (Fig. 2). A circular disc of soft iron A, which forms the rubbing portion and is slightly rounded at the upper surface, is fixed in the centre of the plate U which is cast in non-magnetic metal and is of such a shape as to resist hard shocks. This external plate is fixed in turn by means of three bolts into a bronze collar C, and the latter is imbedded in an asphalt block B of considerable size. This block is hollow inside and forms a receptacle which contains all the working parts. The block is fitted in the pavement, coming about flush with the road level, and its hollow interior part is continued down to the ground by the earthenware pipe T, which rests directly upon the surface of the ground. To the soft iron piece A is fixed a cup-shaped brass cap *e* which is in turn fastened by means of three bolts to an ebonite chamber or vessel Q. This lower vessel which is enlarged at the top tapers down to a cylinder in the lower part and contains a cylindrical iron piece *r* which can move up and down freely.

The tube is closed at the lower end and contains a certain quantity of mercury which surrounds the lower part of the cylinder *r*. The chamber thus formed by the cap *e* and the ebonite piece is hermetically closed by means of a rubber gasket at the joint. The cylinder *r* floats in the mercury and its weight is so proportioned to the quality of mercury that a very slight mag-

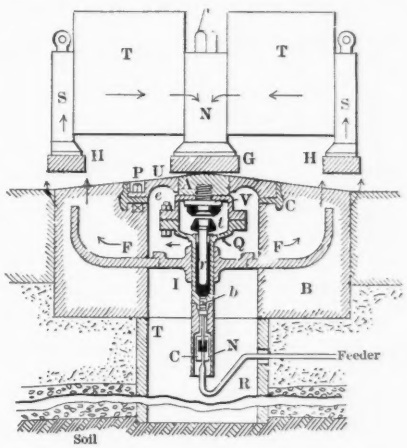


FIG. 2.—DIATTO SURFACE CONTACT SYSTEM.

netic attraction will suffice to lift it up. To the upper end of the cylinder is fixed a conical shaped piece of carbon which is specially prepared so as to be very solid, and has a high conductivity. A second carbon piece V which is turned in the interior to form a conical socket is fixed to the soft iron screw which serves to hold the cap *e* against the piece A. The lower part of the ebonite cylinder Q is stopped up by the copper screw plug which serves to make electrical contact with the mercury in the cavity. A copper wire inserted in the plug passes down inside of a second ebonite tube N which is fixed below the first; this wire serves to bring the current from the underground feeder. The cylindrical part of the device is held in the middle of a soft iron disc I which forms a socket, and the disc is supported at either end upon two curved pieces of soft iron FF′ which have a high magnetic permeability. These soft iron pieces serve as a mechanical support, being embedded in the asphalt block, and also complete the magnetic circuit through the central part of the device and the rails which are carried upon the car above, and the attraction exerted upon the mechanism by the bar is greatly increased. Owing to this construction the whole device is solidly fixed inside the asphalt block, and by lifting up the block from the pavement the whole ap-

paratus is taken out without any further operation.

An automatic connection is made below by a special form of contact device. The lower tube N contains a small metal cylinder or cup C which contains a certain quantity of mercury. This cup is fixed to the end of the feeder wire R which is rigid and holds it in place in the vertical position, so that when the block is inserted in the pavement the copper wire projecting from the screw plug *b* comes down into the mercury cup and completes the circuit. The contact is well protected by the ebonite cylinder which encloses the whole and besides acts as a protecting device should the hollow interior become filled up with water. In this case the air is compressed in the upper part of the cylinder N and prevents the water from reaching the mercury contact.

The magnetic device by which the circuit is closed when the car passes over the block is of a very simple character. The car has a long iron rail suspended underneath it and magnetized by solenoids. The rail rubs over the upper side of the contact block A and in this position it attracts the cylinder *r* which is partly lifted out of the mercury and comes against the under surface of the block. In this way a contact is made between the two carbons, but without lifting the cylinder completely out of the mercury. It still makes contact with the lower circuit and the current passes up from the feeder R through the carbon contacts to the rail under the car which is connected electrically with the motor circuit. The current passes to the motors and thence to ground. As the use of a simple bar would probably not give a sufficient magnetic pull on the cylinder, the effect is strengthened by the device shown in the diagram. The main bar G in the centre, which runs along the whole length of the car, has two similar bars HH′ on either side, separated by a short space. The bars are connected across at intervals by a series of iron covers on which are mounted the solenoids TT. The current from the motor circuit passing in the solenoids magnetizes the system so that the middle bar forms a N pole and the side bars two S poles. The magnetic circuit is completed below through the contact block by the side pieces F which are curved up and come very near the surface so as to leave as short an air-gap as possible. The arrows show the direction of the magnetic circuit.

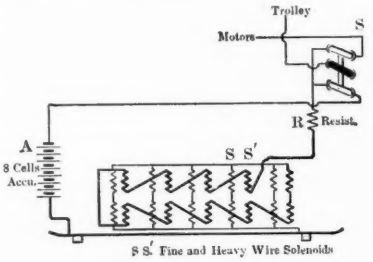


Fig. 3.

As will be noted, the outer edges of the asphalt block are on a level with the pavement, but the block slopes up toward centre so as to allow the metal contact disc to project about two centimetres above the street level. The interior of the block is inspected by removing the three bolts *p* which hold down the cap U, when the whole device can be lifted out of the casing. When replaced, the contact with the feeder is automatically made by the mercury cup C. The contact blocks are spaced along the middle of the track between the rails, and the space between them is less than the length of the contact bar, so that there is always one block in contact.

A simple device has been adopted in order to avoid breaking the current between the carbon blocks and thus forming an arc inside the apparatus. The rear end of the contact rail is curved up slightly, so that as the rail passes ahead the current is broken between the rail and the block at the curved part, but as the rail is still over the block its magnetism is sufficient to keep the cylinder still lifted up against the top, so that the carbons are held together for a short period while the current is being broken above. As the rail passes on the cylinder falls and separates the carbons, but as they are no longer carrying current there is no arc or spark formed in the interior when all else is working properly. As the good working of the system depends in a large degree upon the carbon contacts, special attention has been paid to this point, and at present a very hard graphite carbon is used which is very pure and quite homogeneous. The carbons are very hard and can be turned down in a lathe to the required form and given a high polish. A perfect fit is secured between the head and the upper socket, and owing to the great surface which is employed there is little liability of sticking.

The solenoids which connect the magnetized bars on the car are wound in two circuits, as shown in the diagram (Fig. 3); a heavy wire winding carries the main current from the motors, while a second fine wire winding is used with a small battery of accumulators which is carried on the car in order to magnetize the bar. This is necessary at starting and in some special cases a small battery of eight cells, giving eight amperes and sixteen volts, is used for this purpose. A double-throw switch is used for changing over from the trolley to the underground circuit.

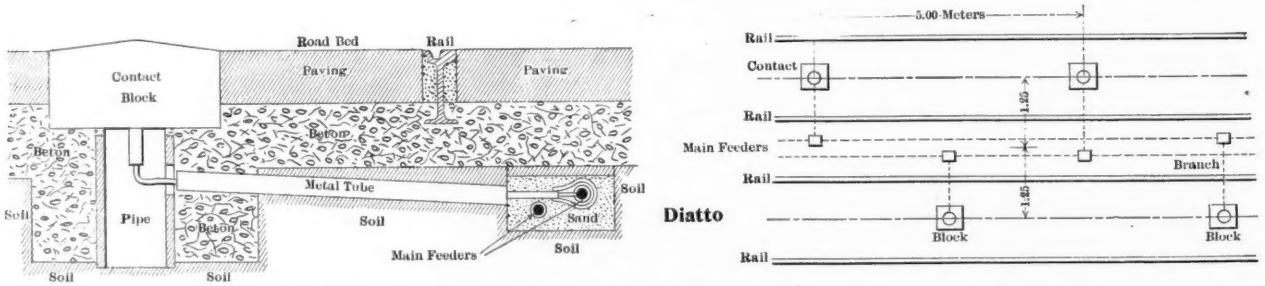
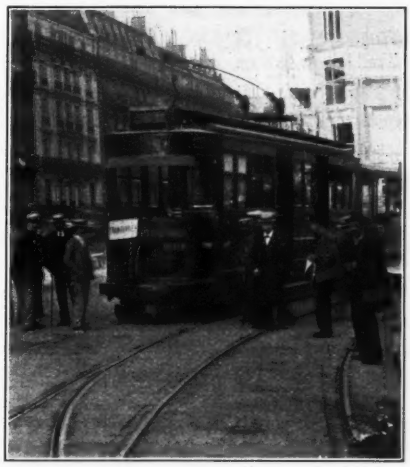


Fig. 4.—Method of Laying the Track and Feeder Connections, Diatto System.

The method of laying the track on the Diatto system is indicated in the section, Fig. 4, which shows the asphalt block in the centre of the track, with the central cavity which is continued down to the soil by the earthenware pipe. Thus any water which might accumulate is drained off directly into the soil. The two feeder wires, one for each track, run along between the two tracks in a trench filled with sand. The feeders are formed of armored cable of fifty square millimetres section. From the cable passes a rubber-covered copper wire which connects the feeder with the contact block. The wire is surrounded by a metal tube of large diameter

which serves to protect it. The asphalt block is supported on a bed of cement beton and is surrounded by the wood or stone paving, as the case may be. The contact blocks instead of being all connected to the same feeder are branched alternately on the first and second feeders, as shown in the plan of the track, so that in case of accident to one of the feeders there will always be a certain number of live contacts on the other feeder and as these will now be spaced ten metres apart or double the distance, the cars will continue to run provided they do not stop on a dead block.

The Clairet-Vuilleumier system of surface contact is now in very successful operation on the Trinité-Enghien line which runs from the centre of the city to the suburbs. The engraving shows a motor car and trailer at the city terminus, with the disposition of the contact blocks. This line is operated by the Compagnie des Tramways Electriques Nord-Parisiens, whose secretary, M. Durangel, has kindly furnished the following data. The surface contact system is used exclusively within the city, but on arriving at the suburbs the cars change over to the usual trolley system. One peculiarity is the use of a double trolley on the cars. This was made necessary as the line uses a section of track which belongs to a system of accumulator cars and the rails were consequently not bonded, therefore a rail return could not be used. After passing over this section, which has a double overhead wire, the single overhead line is reached and one of the trolley poles is lowered by the conductor and held down by a hook. The cars, which are of handsome design, are equipped with two Westinghouse motors of thirty-five horse-power each. The cars have two compartments for first and second-class which are separated by a central platform. The conductor has at hand a small controller drum which enables him to change over from the underground to trolley and also from double to single trolley. The method of supplying the current to the contact blocks and from thence to the car by a friction-bar will be understood from the following figures: The current for the line is furnished by the large three-phase station which is located at Asnierès. Two substations near the track lower the voltage to 550 volts, direct current, by a set of transformers and rotary converters.



CLAIRET - VUILLEUMIER SYSTEM — CAR AND TRAILER AT TERMINUS OF LINE—SURFACE CONTACT BLOCKS PLACED CLOSE TOGETHER AT THE TERMINUS TO ALLOW THE CARS TO APPROACH.

The current from the central station dynamo G (Fig. 5) is sent by an underground feeder X to a series of distributors or automatic relays which are placed along the track every 100 metres. From the distributors start a series of small wires which supply current to each of the contact blocks placed between the rails. These contacts are formed of a simple metallic block imbedded in the pavement and are slightly raised above the surface so that the contact rail which the car carries underneath it can rub over the upper surface. This succession of blocks which receive the current only at the instant when the car passes serve to distribute the current for the motors. As the car continues on its course its contact rail touches the block which is immediately in front without having left the preceding one. As the forward contact is connected to the distributor by one of the wires, a small portion of current is shunted into the distributor and serves to operate a fine-wire electromagnet of high resistance which forms part of the distributor. The latter acts as a relay and sends the main current into the new block, cutting it off from the preceding one, as will be further indicated. From this time on the current for the motor is furnished entirely by the new block until it is in turn replaced by the succeeding one, and so on.

The method of laying the track on the Clairet-Vuilleumier system is shown in the plan view and sections, Fig. 6. Between the rails are the contact blocks p which are spaced 2.50 metres apart. They are formed of a box-shaped steel casting and have about the same shape as the ordinary paving block which they replace. The block is insulated from the paving by asphalt. A copper wire of seven millimetres section is riveted to it to carry the current. The different wires which bring the current from the distributor to the blocks are lodged in an iron tube C which runs along between the rails. Its position is also shown in the sectional view, where CD is the section through the block and AB a section at one of the junction boxes C along the iron piping. A pair of blocks is connected together elec-

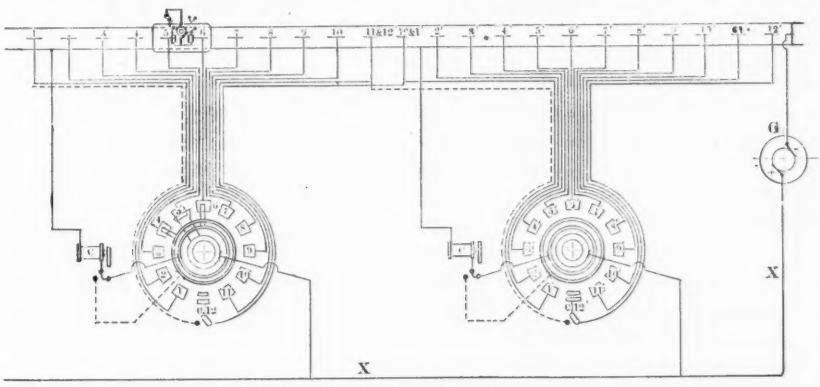


FIG. 5.—CLAIRET-VUILLEUMIER.

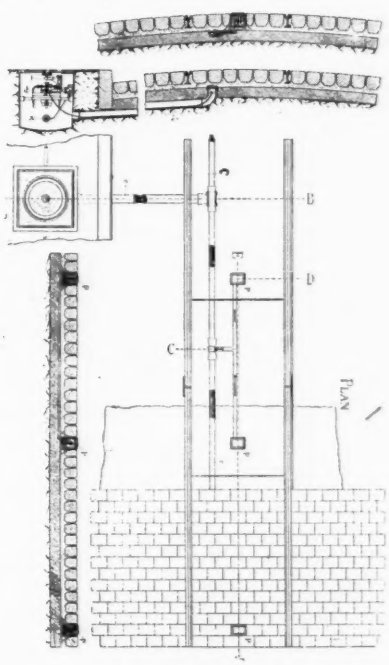


FIG. 6.

trically and is fed by a common wire. The tube carries all the wires that belong to a single distributor, which generally feeds thirty-eight blocks. One of the distributors is seen on the left. It is contained in

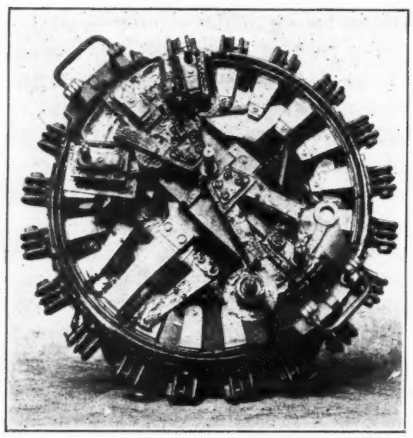


FIG. 7.—CLAIRET-VUILLEUMIER SYSTEM DISTRIBUTOR—TOP VIEW.

a cement vault which is sunk below the level of the sidewalk and has a manhole with a flush cover.

The distributor is a simple and ingenious device which serves to connect one after another of the blocks to the main circuit upon the passage of the car. Contrary to the Diatto system, where the mechanism is contained in the block itself, in the present case the block is a simple piece of metal and the contacts are shifted from one block to another by a kind of progressive relay or rotary switch. The photographs show one of the distributors for nineteen contacts or thirty-eight blocks (two blocks being connected together). The engraving, Fig. 7, shows the top view of the distributor, and Fig. 8 a view from below, while the diagrams, Figs. 9 and 10, explain its ac-

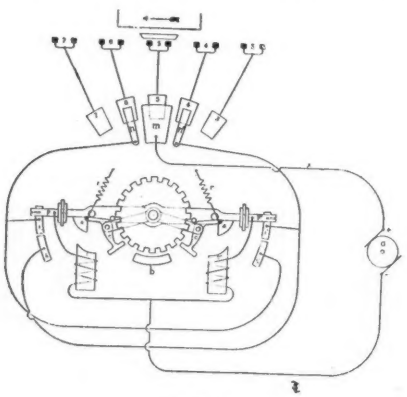


FIG. 9.

tion. The distributor is provided with twenty contact plates which are mounted on a circular metal casting. These twenty switch points are insulated from each other. The circle is held upon a central plate provided with vertical feet or supports, as seen in the lower view. The base-plate carries a bearing which supports the central shaft carrying the revolving parts. On the shaft is carried a wheel which contains a certain number of notches corresponding to the number of switch points, also three contact plates, *n, m, n,* which are solid with the notched wheel. The three contact plates are insulated from each other and rest upon three consecutive switch points. There are three brass rings which form a collector and maintain the electrical connection between the three contact plates and the three binding-posts on the frame of the apparatus.

The middle plate *m* serves to distribute the current which it receives from the main feeder cable X. It is larger than the interval comprised between two switch points, so that it comes in contact with the following point before it leaves the preceding one. The two other plates *n n'*, placed symmetrically on each side of the

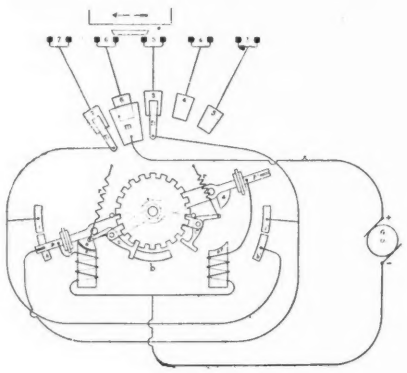


FIG. 10.

larger one, are of smaller size and leave one point completely before engaging with the second. Each of the three plates is connected by means of a commutating device with the entry wire of an electromagnet and the outer wire of the magnet goes to the rails of the track or to ground. There are two such electromagnets which will be noticed below the frame. They are provided with an armature in the form of a double anchor which is solid with the swinging bar of the commutator. This armature oscillates to and fro between the poles of the magnet. The action of the distributor will be clearly observed from the diagrams, where the parts are shown in simplified form. The electromagnet *e* on the left is the only one to be considered at present, as the second magnet is used when the car travels in the opposite direction on the track. In Fig. 9 the car is passing in the direction of the arrow and takes current from the pair of blocks No. 5. As the car passes to the left it takes the position which is shown in the second diagram. By means of the contact rail on the car, a circuit is formed between the main

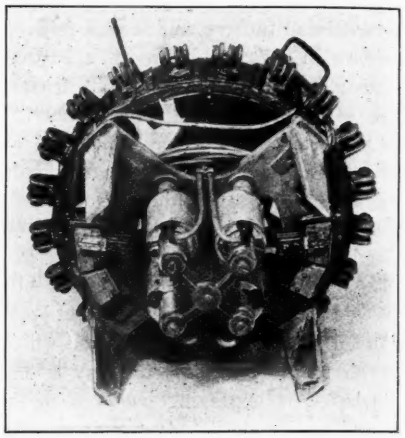


FIG. 8.—CLAIRET-VUILLEUMIER SYSTEM DISTRIBUTOR—BOTTOM VIEW SHOWING SOLENOID WHICH OPERATES THE MECHANISM.

switch plate *m* and one of the small ones *n'* which has the effect of exciting the corresponding electromagnet or that on the left-hand side *e'*. The magnet causes the armature to swing in the direction as shown in the second case, Fig. 10, and as the armature is drawn down the pawl *c* engages with one of the teeth of the ratchet wheel and thus causes the wheel and the main contacts which are fixed to it to advance by one-twentieth of a revolution. By this movement the three contact plates *n, m, n'* are made to shift by one switch point and the car is now supplied with current by the following pair of blocks No. 6. At this moment the pawl is stopped by a piece *b* which limits its course and in consequence the rotary movement of the armature and the three plates. This condition holds good until the car has advanced beyond the block No. 5. Then the shunt current ceases to pass in the electromagnet and the pawl is brought back by a spring which works against the action of the magnet. This causes a reverse movement

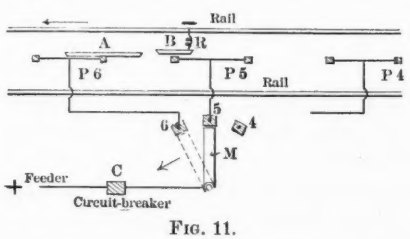


FIG. 11.

of the armature and bar, and brings them back to the starting point, that is, in a position which is symmetrical with respect to the electromagnet (Fig. 9).

In the back movement the spring draws

the pawl out of the ratchet wheel so that the latter remains in its newly acquired position, and with it the plates *n, m, n'*, which have thus been made to advance by one-twentieth of a revolution. As the car continues, the shunt current is again established in the electromagnet and the same operation takes place, shifting the contact pieces by another twentieth of a revolution, and so on, and the blocks of the section are thus supplied with current as the car advances. After passing the twentieth block the distributor has made a complete revolution. The car then comes on to the blocks which are fed by the second distributor and the action continues in the same way. The first distributor is then ready to operate with the next car. The different distributors are connected together by a circuit which allows the shifting from one to the other to take place properly.

The rail which is carried underneath the car in order to take the current from the blocks to the motor circuit is formed of a piece of angle iron 3.30 metres long with the flat surface presented to the blocks. It is supported by a spring device which presses it against the blocks.

The car carries a second contact rail which is placed behind the main rail and acts as a safety device. The second rail is a short piece of flat iron about one metre long. The diagram, Fig. 11, shows the action of this device. It serves to cut off the current should anything happen to a distributor. At A is the main contact rail and B the small rail. The latter is connected through a low resistance R with the track. Below are shown three of the switch points 4, 5 and 6 corresponding to the pairs of blocks P 4, P 5, P 6, as above indicated. As the car advances in the direction of the arrow it leaves P 5 and comes upon P 6. Hence the revolving contact *m* should have been shifted on to the switch point 6, as shown by the dotted lines. Should the apparatus fail to work at this point, *m* will remain in No. 5 as shown. When the back rail B comes upon P 5 the circuit is completed directly through *m* and B to ground. The strong rush of current is sufficient to open the automatic circuit-breaker C, and the distributor is now cut off from the main feeder. The blocks of the section no longer receive current and the car comes to a stop. The distributor is then inspected to remove the trouble. When the car arrives on the trolley section the motorman takes off the small rail and stores it on the car. The main rail is raised up off the track by a lever device which is worked by a handle at the side of the car.

AN INTERVIEW WITH MR. MARCONI.

THE FAMOUS YOUNG ITALIAN INVENTOR ARRIVES IN NEW YORK WITH SEVERAL NEW IDEAS FOR THE DEVELOPMENT OF HIS WIRELESS TELEGRAPH.

Mr. William Marconi, the inventor of the Marconi system of wireless telegraphy, arrived in New York, Saturday morning, August 29, on the Cunard steamship Lucania. It was known that Mr. Marconi on this occasion had brought with him the practical consummation of several new ideas which are to be applied to the working out of the system of telegraphy of which he is the inventor.

One of the characteristics of Mr. Marconi is that he is at all times approachable and is willing to concede to the public as much information as it is possible to give under ordinary circumstances. The representative of the ELECTRICAL REVIEW called on Mr. Marconi and found him entirely willing to discuss his invention, and only sorry that he could not give out more detailed information because of the patent situation covering the latest applications of his apparatus. Mr. Marconi is possessed of a peculiarly frank disposition, and a talk with him gives one the instant and distinct idea that there is a bona-fide proposition behind everything which Mr. Marconi stands for.

With regard to the service of the wireless telegraph system during his trip from England, Mr. Marconi stated that the Lucania had been in constant communication with both sides of the Atlantic. The latest news from Paris and the Continental capitals was received simultaneously with the most recent information with regard to events in the United States. While the work that he intended during this trip was purely of an experimental nature, he had reason to be pleased with the absoluteness of communication which was established and maintained throughout the trip.

"Are messages being sent regularly between Poldhu and the Canadian station?"

"Not regularly; messages have been sent —not as many as some people might believe—but sufficient has been done to demonstrate that this is absolutely practicable, though, at the same time, everything that has been done is of a purely experimental nature."

"Does the new apparatus which you have developed and are developing, relate to both the receiving and sending apparatus?" "Yes; with these devices there will be a material difference in the height of the sending and receiving antennæ, and also a difference in the method and speed of operation, both in sending and receiving wireless messages."

When asked for his opinion as to the part the earth played in the transmission of wireless messages, Mr. Marconi stated it was his profound opinion "that the earth played a very important part in making wireless transmission possible. It does not play the all-important part, but its part is very significant."

"Have you kept in touch with what has been done at the recent conference at Berlin?" "Yes, I have kept in close touch with the latest developments that are being made in wireless telegraph systems everywhere, and I am possessed of full information as to what has been done at the international conference on wireless telegraphy at Berlin."

"Have you said that wireless telegraphy on a commercial basis would be established within three months?" "No, I do not talk like that; I am not responsible for such statements. I wish to be understood as conservative, and am adverse to having any of my information effected with a 'thrill.'" Mr. Marconi felt confident that ultimately, and at no very distant day, commercial wireless telegraphy would be established, but he would not say in how many days this would be accomplished.

"Is Mr. Edison cooperating directly with you?"

"Well; not directly, but rather in a consulting capacity; I have just talked with Mr. Edison, and told him a few of my ideas, and Mr. Edison has told me a few of his. I am greatly pleased to have Mr. Edison's confidence and to have had such a pleasant day with him."

Mr. Marconi said that just at present he was very busy with his patent attorneys, and that, while he appreciated the interest the public had taken in everything he had done, and the widespread desire there was for information as to the workings of his system, he had not found time to prepare any literature other than those addresses which he had delivered before the Continental and other learned societies. He was pleased at all times to give information whenever possible. At the present time, the technical details of his new apparatus would not be available, owing to the patent situation. After consulting with his patent attorneys, it was Mr. Marconi's intention to go to Canada to install new apparatus and conduct extensive experiments with these devices.

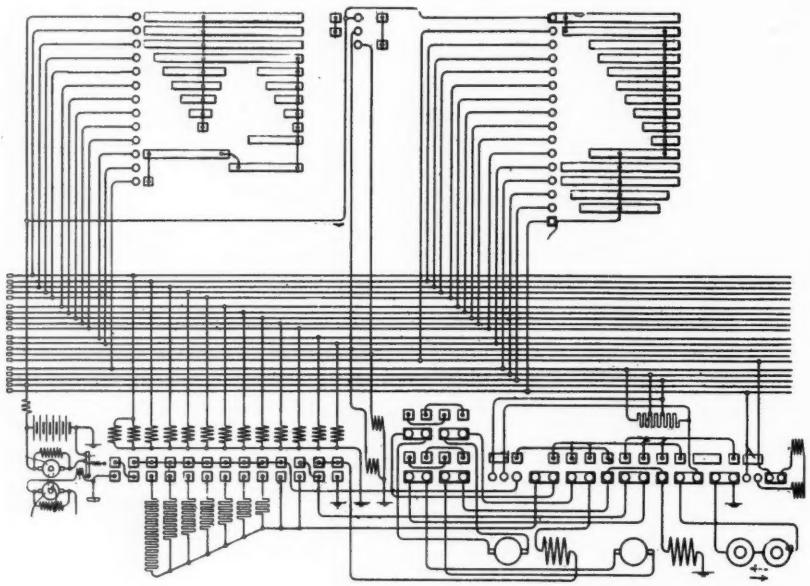
"How is the Canadian Government treating you now?" "The Canadian Government," Mr. Marconi said, "is very kind and has given me every encouragement, and I can only speak of it with the utmost courtesy."

Referring to the technical press, Mr. Marconi said that the press of the United States had been uniformly kind and that he appreciated this action on the part of the American editors very much.

Personally, Mr. Marconi has a delightful manner of speaking and impresses one with his frankness and modesty.

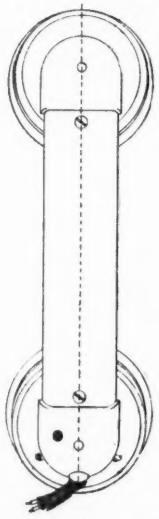
Electrical Patents.

In order to obtain the greatest tractive and accelerating effort on a train propelled by electric motors, it is necessary to divide the motive force into a number of units and to apply the several units to the axles of the different cars. To successfully operate a train having a number of motor-cars, it is necessary that the controlling be done from a single point on the train; otherwise the motor of one car may be called upon at times to do an amount of work which differs materially from the amount being done by the motors of another car. To reduce the complications of a train system to a minimum and to enable the train to be conveniently made up of different lengths, as may be required, it is desired to make each motor-car a complete unit in itself—that is to say, to provide it with a contact device, motor or motors, and a suitable controlling mechanism, which is arranged to work in conjunction with other controlling devices on the train. The system should be so arranged that any number of similar cars may be coupled together in any desired order or position, and that all the motors of the train may be controlled from any one of the cars. Further, it is highly desirable that the contact devices on each car should take current sufficient for the needs of that particular car only and that the heavy currents which actuate the motors should not pass from car to car. A patent has been granted to Frank E. Case, of Schenectady, N. Y., and assigned to the General Electric Company, of New York, on a new system of train control, the principal object of which is to provide a system of train control fulfilling the requirements above set forth, such that from any selected point on the train all of the machines may be made to act simultaneously and equally to accelerate the train or to maintain it in motion in either direction or to retard it evenly and strongly and that all of these actions in all cars of the train may be under the control of a single motorman. In carrying out the invention, the motors of the train are divided into sets, each set preferably comprising the motor equipment of a single car, and to govern each set of motors by a separate set of motor-controlling devices, and further, to provide at a number of selected points on the train master-controllers so arranged that each desired master-controller will actuate all of the motor-controllers. It is obvious that with the arrangement above outlined at any particular time the train as a whole will be operated from a single selected point. It is one object of the invention to provide means sufficient to prevent any successful attempt from any other point to interfere with such operation. To this end an interlocking arrangement is provided, preferably electrically controlled, such that any movement of either of the master-controllers from its off position will automatically lock all other master-controllers of the train. These devices are preferably so arranged that as long as all of the master-controllers are at the off position any one of them may be operated, while the operation of that one will lock all of the others. It is another feature of the invention to provide each of the master-controllers with three switches—the power switch, the reversing switch and the breaking switch, respectively, and to divide the motor-controllers into corresponding switches or divisions. A still further feature of the invention is to accomplish a part of the motor control, as the usual series-parallel and resistance steps, by a number of separate contacts or switch-blades, while the other steps are provided by the action of controller cylinders or their equivalents. All of these devices should be controlled or actuated by electromagnetic means.



System of Controlling Electric Cars.

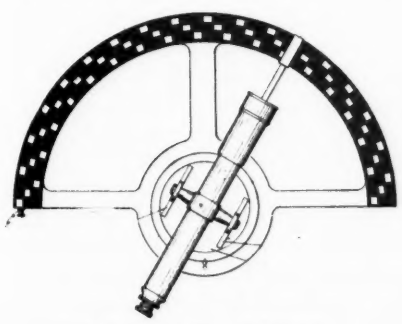
A telephone of novel construction has been patented by John A. Barrett, Louis A. Falk and Herbert E. Shreeve, of Boston, Mass., and the patent assigned to the American Telephone and Telegraph Company, a corporation of New York. The invention relates in particular to such telephones as have the transmitter and receiver combined in a single instrument, and are therefore especially adapted for use of linemen, inspectors, or other employés. It is comprehended in a telephone instrument having a handle-bar to be grasped by the hand of the user, to the ends of which the receiver and transmitter are respectively attached in such wise that the former can be held in approximation to the ear and the latter held simultaneously near the mouth of the user. The object of the invention is to provide a combination instrument which shall be compact, of light weight and high efficiency, and which, though utilizing a granular carbon transmitter, shall ensure that when in use with the mouthpiece and receiver in proper juxtaposition to the lips and ear of the user the granular variable resistance button shall be held in



Telephone Transmitter.

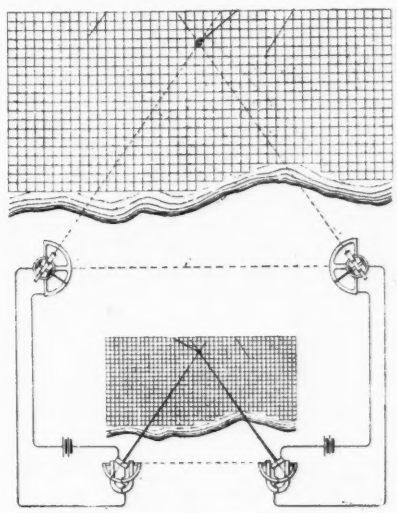
a position most favorable for successful operation. By the present invention the great advantages inherent in the use of the granular carbon transmitter may be obtained without introducing any counterbalancing mechanical defects. Accordingly a prominent feature of the invention consists in certain improvements in the construction of the handle-bar, the transmitter, and the means for attaching one to the other, whereby it is provided with certainty that when the combined instrument is in use the diaphragm and carbon-containing button attached thereto shall be caused to assume a position inclined at a moderate angle from the vertical, such position being adapted to ensure the highest operative efficiency of the transmitter, the mouthpiece or passage directing the sound-waves of the voice upon the diaphragm being at the same time brought into an effective position to receive the said sound-waves substantially opposite to or in front of the lips of the user. The invention consists also in providing a cap or socket, each of corresponding shape to the one end of the handle-bar, at the back of the transmitter and receiver, in making the handle-bar hollow to contain the connecting-conductors, and in socketing and securing the ends of said handle-bar in the correspondingly shaped caps or sockets of the said transmitter and receiver; the cap or socket of the transmitter being formed with an orifice for the ingress of such circuit-conductors as are required. The caps or sockets are preferably removably secured to the transmitter and receiver.

An electrical range-finder has been patented by Harry Shoemaker, of Philadelphia, Pa., and has assigned one-half



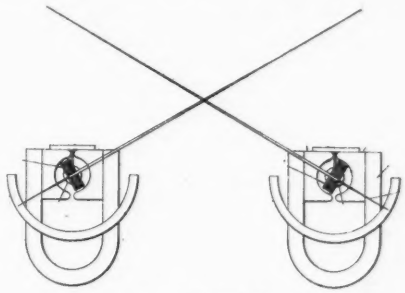
ELECTRICAL RANGE-FINDER.

to Marie V. Gehring, also of Philadelphia, Pa. The invention relates to a system for determining the relative position of an object as, for example, the position of a vessel with respect to fortifications. The object of the invention is to indicate at any point or station the relative position of a distant object, so that an operator or gunner at such point or station may without observations of his own properly direct and control his apparatus. The system and the apparatus therefor constitute a range-finder whereby a gunner may be constantly advised of the relative position of the object upon which he is to train his gun, though such object may not be visible to him. In the system two indicators are independently controlled by as many independent sighting instruments, and it is upon the resultant indications of these two indicators that the gunner depends for his information. Each sighting instrument controls its indicator by electrical means, and these indicators cooperate to indicate the point upon a chart, such point signifying to the gunner that the object at which he is to fire is located in the same



ELECTRICAL RANGE-FINDER.

relative position as this point on the chart. The sighting instruments comprise telescopes rotatable in a horizontal plane about a vertical axis and means operated by the motion of such telescope to vary a characteristic of an electric current. The electric current in the circuit of the instrument controlled by the telescope has a different characteristic or is of a different magnitude for each angular position of the telescope. Each indicating instrument is, in fact, a Deprez d'Arsonval galvanometer consisting, as is well known, of a permanent magnetic field in which is mounted for movement about its axis a coil connected in the circuit controlled by the sighting instrument. Attached to the movable coil is a long slender needle or pointer, which by the system will always be at the same angle with respect to some reference line as between the longitudinal axis of the telescope and a corresponding reference line. In other words, the needle or pointer of the indicator follows accurately and smoothly every movement of the telescope of the sighting instrument. Two sighting instruments and two indicators are employed. Each sighting instrument is trained upon the distant ship or object, and this results in the indicating pointers or needles following the movements of their respective con-



ELECTRICAL RANGE-FINDER.

trolling telescope and the point of intersection of the needles or pointers corresponding with the location of the distant ship or object.

Fourth General Meeting of the American Electrochemical Society.

The fourth general meeting of the American Electrochemical Society will be held at Niagara Falls, N. Y., September 17, 18 and 19. The society's headquarters will be at the Cataract House. Papers will be read in the morning, and Thursday and Friday afternoons will be devoted to visits to power-houses and certain electrochemical plants. The evenings will be given up to social entertainments. Saturday evening a trip will be made to Niagara-on-the-Lake, Youngstown and Port Niagara by boat and trolley.

The following titles of papers have been announced: "A new Type of Electrolytic Cell," P. G. Salom; "Manufacture of Ferro-Alloys in the Electric Furnace," Dr. George P. Scholl; "Electrolytic Copper Refining," Dr. W. D. Bancroft; "Electrometallurgy of Gold," Dr. W. H. Walker; "Some Theoretical Considerations of Resistance Furnaces," F. A. J. Fitzgerald; "On the Supposed Electrolysis of Water Vapor," F. Austin Lidbury; "Efficiency of the Nickel-Plating Tank," Professor O. W. Brown; "Electrolysis of Sodium Hydroxide, by Alternating Current," Carl Hambuechen; "A Practical Utilization of the Passive State of Iron," Professor C. F. Burgess; "The Present Status of the Theory of Electrolytic Dissociation," Dr. E. F. Roeber; "Berthelot's Law of Electrochemical Action," C. J. Reed.

One session will be devoted to the discussion of the theory of electrolytic dissociation, to be opened by Dr. W. D. Bancroft.

Further information as to the meeting may be obtained from the local secretary, C. L. Collins, 2d, Niagara Falls, N. Y.

Reviews of Current Engineering and Scientific Literature.

New Properties of Coherers.

In studying the variation of resistance of coherers as a function of time during which they are acted upon by electrical waves, it is found that a certain minimum exists. If the stable equilibrium corresponds to a value in the neighborhood of this minimum, the condition is that of an ordinary coherer. If, on the contrary, equilibrium is unstable, the coherer can decohere itself spontaneously, becoming self-decohering; or, due to the action of the electric waves, becoming anti-cohering. M. Hurmuzescu has studied this phenomenon, and offers the following explanation of the behavior of the coherer under the different conditions: The action of the electric waves produces between the metallic grains sparks, which cause them to weld, producing real coherence, or brush discharges which oxidize the grains and increase the resistance of the metallic chain, producing anti-coherence. If the metal is not in an oxidizing atmosphere and the cohesion is not determined by welding, the brush discharge ceases at the same time with the electrical waves and the resistance increases, producing auto-coherence. — *Translated and abstracted from l'Industrie Electrique (Paris), July* 25.

An Italian 30,000-Volt Power Transmission.

The Societe des Forces Mortrices du Mont Cenis, Italy, has under construction a plant for the transmission of power to the city of Turin from the small Alpine river, the Cenischia, at the foot of Mount Cenis. The available head of water is one of the largest utilized on the Continent. The height is 865 metres, which is divided into two parts, a lake being situated half way down. The total power available is about 12,000 horse-power. By using the lake as a reservoir this may be increased to about 16,000 horse-power. The station now existing includes three sets of 1,600 horse-power each. Each set includes a turbine direct-coupled to a three-phase alternator. The turbines have a normal power of 1,600 horse-power and are connected by Zodel elastic couplings to alternators rated at 1,400 kilowatts. The latter are three-phase machines of the revolving-field type, twelve poles, and at a normal speed of 500 revolutions per minute generate 3,000 volts, fifty cycles, with an output of 270 amperes. The generator full-load efficiency of the alternators is 96.5 per cent; at three-quarters load it is ninety-six per cent and at one-half load it is ninety-five per cent. The machines are excited by a separate generator driven by a small turbine. The voltage of the transmission lines is 30,000, the length of line between generating station and the city of Turin is forty miles. The transformers are of the shell oil-bath type, the oil being cooled by water circulating in rings in the top part of the transformer casings. Electric pumps are used to circulate the cooling water. The transformers are of the single-phase type connected in sets of three, there being four in each group, one transformer being held in reserve. The switchboard is divided into generator and feeder panels, and is equipped with automatic oil-break switches to avoid the use of fuses. High-tension ball lightning arresters and static ground detectors are provided. The switchboard was tested to double the working pressure of the installation.—*Abstracted from the Electrician (London), August* 10.

Recent Work on Thorium.

In this article Mr. C. F. Soddy describes the work recently carried out by himself and Professor Rutherford on radioactive substances. Thorium and radium, but not uranium, were found to be giving off a gas of no chemical affinity and in very small quantities in addition to their radioactive property. This gas can only be ascertained by the fact that it gives out rays like those of the substance from which it comes. The material character of these emanations was established recently by the aid of liquid air. By means of this they were condensed and the boiling point found to be minus 130 degrees centigrade. Mr. Soddy points out the extreme delicacy of the electrometer, which for this work far surpasses not only the most delicate balance but even the spectroscope. It is found that the rays from the emanations of these substances do not go on forever like those of the radioactive substance, but decay rapidly and disappear. They leave, however, an invisible film of radioactive substance on any solid with which they come in contact. If this film is scraped off with sandpaper and dissolved in acid it continues to give off these rays, gradually dying out, but the substance can be traced through two more metamorphoses before it finally becomes inert and commences to decay. Although thorium is an element, yet all this radioactivity can be concentrated into a very small part of it. If ammonia is added to a thorium solution the thorium is precipitated in a very inactive condition, while the little remaining in solution retains all the radioactivity. This it gradually looses, while the rest of the thorium regains its activity at the same rate. This process may be repeated. To explain by what process a chemical element like thorium may come to be the progenitor of five new forms of matter, the following ideas are given: As each atom breaks up and emits its rays, a new system remains, this latter is also unstable and in its turn breaks up and emits its rays. This process goes on to the fifth stage, after which all is at an end so far as experimental researches have been able to determine. In answer to the possible objection that such large quantities of energy can not evolve from such small masses, the suggestion is made that this should not be considered an objection, because this is our first experience with atomic energy, and we have nothing to compare with.—*Abstracted from the McGill University Magazine, July* 1.

The Danger of Shock to Firemen through Squirting at High-Tension Mains.

This gives an abstract of the recent German paper by Herr F. Heinicke, who has carried out some experiments to determine what danger there is to firemen when there are high-tension transmission lines close to a building which may be struck by the stream of water from the fire hose. A stream of water at a pressure of five atmospheres was taken from a hose with an unusual diameter of twelve millimetres and was directed at a bare wire carried on well insulated supports. The full section of the stream was allowed to hit the wire and the voltage from the nozzle to the earth was measured by means of a standard voltmeter, the copper mouth of the hose being insulated thoroughly from the earth. Experiments were carried out with continuous and alternating currents, and with various distances between the nozzles and the wire. Ordinary city water was used first and then one-half per cent of soda was added to increase conductivity. Experiments carried out by Weber and Kath have shown that a human being can stand a current of 0.03 ampere without fatal re-

sults, although a severe shock would be experienced. The following are the results of the tests: On a three-phase, star-connected circuit, with 6,000 volts between lines and the neutral earth, the tests show that a distance of 300 millimetres is sufficient for safety with pure water, with the soda solution the distance must be increased, before the current falls to 0.03 of an ampere. On a three-phase circuit with 125 volts between lines with one of the mains grounded, the distance between the nozzle and the wire could be reduced to thirty millimetres. On a continuous-current traction circuit supplied from accumulators at 550 volts with a negative pole earthed, with pure water, and a distance from nozzle to wire of thirty millimetres, the current was only 0.016 ampere. With the soda solution and the same distance, the current was 0.03 ampere. With a 240-volt continuous current the value of current was not reached at all with either pure water or soda, although the distance between nozzle and wire was reduced to fifty millimetres. These figures seem to show that the danger from this source is not so great as is usually supposed.—*Abstracted from the Electrical Engineer (London), August 7.*

The Hampshire, England, Electric Railways.

This gives a detailed description of the system of electric railways which has recently been completed in Hampshire, England, by the Hampshire Light Railways Company. This railway serves a purely country district and extends from the outskirts of Portsmouth to Horndean, a distance of about six miles; and as the road was opposed by landowners, a private right of way was acquired. The system is worked in conjunction with the Portsmouth municipal railway system, and the necessary electrical energy for operating the line is purchased from the Portsmouth Corporation. The rails are of the ordinary grooved girder type, weighing ninety-six pounds to the yard, and made in lengths of forty-five feet, with a percentage of shorter lengths, to avoid cutting rails in the construction of loops. The overhead construction combines a special form for light railway work with the ordinary form of bases, brackets, etc. The system adopted is centre-running, the trolley wire—which is No. 00 B. & S. gauge—being in duplicate and carried over the centre of the track. The trolley line is divided into half-mile sections, a feeder pillar being erected at each place, having, in addition to the usual four-line switches, a sufficient number of main switches to allow the main cables to be disconnected for making a loop test in case of a breakdown. The switches are mounted on marble panels and fitted with cast-iron pillars with water-tight doors. As the end of the line is a considerable distance from the Portsmouth power-house, power is transmitted to this section at 6,000 volts, three-phase. There are two motor-generator sets in a substation about midway along the line. Current is carried by a specially constructed three-core cable to the substation. The cable is lead-sheathed, and under this lead-sheathing is bound a copper earthing strip. The insulating material used is specially impregnated paper which has been tested after the cables are constructed at 20,000 volts, alternating current, for fifteen minutes. All cables are laid on the solid system. The cars are the double-deck type and weigh, equipped, about seven tons ten hundredweight. They are provided with an electric rheostatic brake and a mechanical track brake.—*Abstracted from the Tramway and Railway World (London), August 6.*

The Auvert Train Lighting System.

The Auvert system of train lighting is discussed in this one of the series of articles on train lighting by Herr R. Geotze. This system belongs to the class of complete car equipments consisting of a dynamo and a storage battery. It may be considered as a modification of the Stone system and it has been put in use on some trains of the Paris-Lyon-Mediterranean Company. The difference between the Auvert system and the Stone lies in the method of driving the dynamo and of maintaining a constant voltage. The dynamo is hung from the car frame on an axle parallel to the length of the car, this arrangement preventing much of the side jarring. It is driven through an extended shaft also parallel to the length of the car and upon the end of which is a leather friction wheel which is pressed against the side of the running wheel of the truck by means of springs. The normal output of the dynamo at 1,350 turns per minute is thirty amperes and 15.5 volts. The accumulator equipments consist of eight elements of the Boese system with a capacity of 180 ampere-hours. A current of twenty amperes is necessary for lighting the car, so that the batteries are sufficient for eight or nine hours. The battery cases are celluloid enclosed in wood, four batteries being assembled in a set and the two sets arranged distribute the load equally on the car. The voltage is regulated by a small two-pole series motor carefully boxed in and placed under the car where it is easily inspected. The axle of this motor carries a bronze pulley against which a brake is pressed by means of springs. The tension of the springs is so regulated that the frictional resistance of the brake is sufficient to hold the motor stationary until the current exceeds twenty-eight amperes. If the speed of the train exceeds fifty kilometres per hour, the output of the generator is greater than twenty-eight amperes and the motor begins to run setting up a counter-electromotive force which reduces the voltage at the lamps to the normal. The greater the speed of the train the greater the counter-electromotive force. The system makes use of automatic electric switches and pole changes for cutting in and cutting out the dynamo and reversing the generator connections when the direction of motion is reversed.—*Translated and abstracted from Centralbatt Für Accumulatoren-Elementen-und Accumobilen Kunde (Gross-Lichterfiede-West), August 1.*

Reduction of German Cable Rates to the Orient.

The Imperial German Post and Telegraph Department recently issued an order reducing the cable rates for messages to China, Japan, Korea, Manchuria and the Philippines on and after July 15, 1903. It now costs to send messages to the following countries, per word not exceeding fifteen letters:

To China, Manchuria excepted.....	$1.08
To Korea:	
Chemulpo, Fusan and Seoul.....	1.21
Other places.....	1.29
To Japan.....	1.21
To the Philippines:	
Luzon.....	1.08
Panay, Cebu and other stations....	1.18
To Manchuria.....	1.08

These rates are for messages *via* Emden, Vigo, Vladivostock and Nagasaki. It is further announced by the postal authorities that after July 15, 1903, the use of cable codes may again be resumed in sending messages to Spain. Cablegrams for Honduras, Venezuela, Nicaragua, Costa Rica and Columbia will only be sent at the sender's risk.

The British Iron Trade Association points to the remarkable activity of German iron and steel manufacturers in the distribution of their products in Great Britain, while American manufacturers are becoming lethargic competitors. The report expresses the opinion that Germany's exports of iron and steel manufactures will in a short time equal those of Great Britain.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Development of Enclosed Fuse Protective Devices.

No recent development in electrical construction devices has met with more rapid advancement and success than the so-called enclosed fuse which is to-day supplanting nearly all forms of open fuse protective devices. Actual commercial exploitation was begun but five years ago; yet to-day the enclosed fuse has been accepted almost universally and is to-day being demanded by the underwriters, and in fact it finds a place in almost every new plant. At first it was thought that the increased cost of the necessarily more expensively constructed enclosed fuse device would to a great extent prohibit the universal application of this meritorious protective device; yet it was soon found that the many advantages accruing from the use of enclosed fuses warranted the additional expenditure.

The development of enclosed fuse protective devices is somewhat noteworthy, as their application has been almost universal, not only to ordinary interior work, but for street railway motor protection, transformer protection, switchboard work, and a multitude of other service. The Sachs "Noark" enclosed fuse, marketed by the H. W. Johns-Manville Company, sole agent, was one of the pioneers in the enclosed fuse field. The basis for the development of this now well-known protective device began more than a dozen years ago. The original Sachs patent of 1894 is claimed to be the first showing the modern form of constructing enclosed fuses.

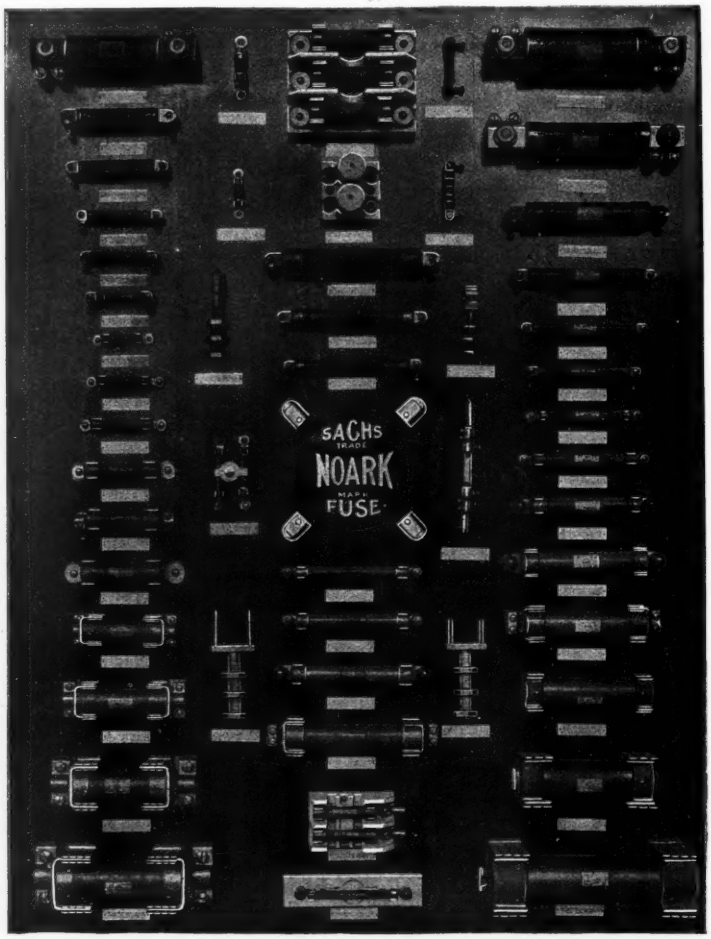


EXHIBIT SHOWING DEVELOPMENT OF FUSE PROTECTIVE DEVICES.

The variety of styles and types of enclosed fuse protective devices marketed by the above-mentioned concern is exceedingly extensive and covers almost every branch of electrical service. The illustration herewith shows some of the different types and styles of enclosed fuses and cutouts included in this line. It is also of interest to note the large ampere sizes to which these fuses have been developed on the various voltages in common use. Recent tests made of Sachs "Noark" fuses on a 4,000-ampere-hour storage battery at 250 volts have demonstrated the entire efficacy of fuses whose normal carrying capacity was 400 amperes at 250 volts (100,000 watts). These fuses were short-circuited dead on the terminals of the battery and operated absolutely without smoke, flash or any demonstration whatever, yet indicating upon the exterior of the tube their interior condition. Larger sizes are also being developed, and it is expected that they will be furnished up to 1,000 amperes in the near future. As a circuit-rupturing performance, the opening of an enclosed fuse capable of carrying 500 or 600 amperes at 250 volts absolutely without any external demonstration or explosion whatever, and without in any way affecting the integrity of the tube or external structure, is certainly noteworthy.

New Motor Cars of the Central London Railway.

The new electric motor cars which take the place of the separate electric locomotives formerly used in the operation of the line have a motor truck on one end only. The cab covers the entire length over this truck, behind which the steel underframe is dropped low to receive the body of the car. The cab is nine and one-half feet long and six and one-half feet wide over the frames, while the width over axle boxes is seven feet two and one-half inches. The wheels are thirty-four inches in diameter with a wheel-base of six feet. With a current of 200 amperes at 500 volts each motor is designed to give a tractive effort of 2,500 pounds at the rail, and a speed of not less than eighteen miles an hour. At eighty amperes and 500 volts the tractive effort is 650 pounds and the speed twenty-seven miles an hour. The gear ratio is one to four, with cut steel gears. There is a motor-driven air compressor, with a capacity of thirty-five cubic feet of free air per minute compressed to ninety pounds pressure in a main reservoir of eight cubic feet capacity. When the pressure reaches ninety pounds the motor is automatically cut out, but the circuit is closed again when the pressure has fallen to eighty pounds. The Westinghouse quick-acting brake is used, and a hand brake is also fitted.

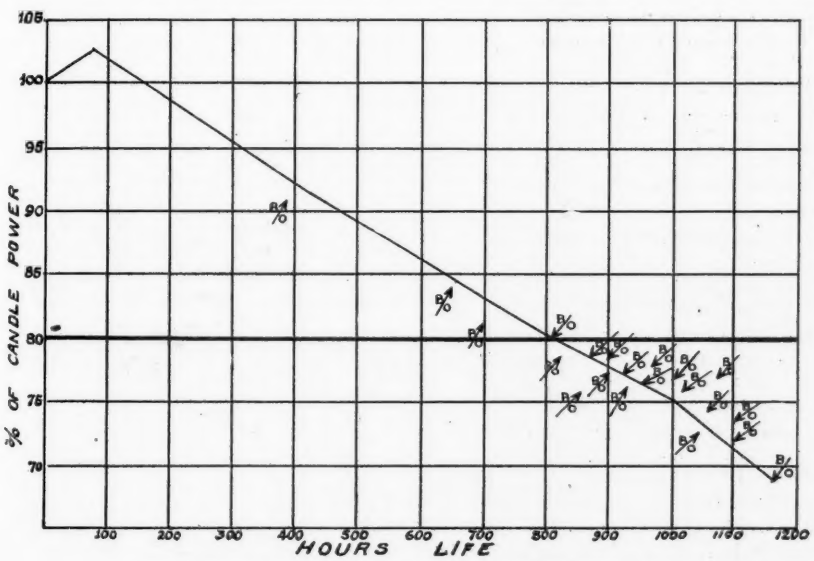
A New Departure in Incandescent Lamps.

The Bryan-Marsh Company, New York and Chicago, has developed a type of incandescent lamp which will no doubt prove a very attractive proposition to central station managers. One of the greatest obstacles in the way of satisfactory service by means of incandescent lamps lies in the fact that, no matter how well an incandescent lamp may be made, there comes a time when, in spite of the greatest care in regulating the voltage and in submitting the lamp to severe shop tests before packing, the lamp begins to grow dim, and it becomes a very inefficient piece of apparatus.

Realizing the dissatisfaction which arises from the poor illumination of a lamp which has outlived its useful life, to say nothing of the poor economy from an operating point of view, central station managers have often found it expedient to go out over their lines at certain periods and renew all lamps which have fallen below a certain predetermined standard of candle-power.

The advantages, then, of a lamp that would always be bright and never grow dim throughout its useful life, provided this life were of sufficient length to justify its installation, are evident. This is just what the Bryan-Marsh Company is aiming at in the production of its new type of incandescent lamp. The accompanying drawing is a reproduction of an average curve sheet, and shows the results of a test on a number of lamps constructed upon this principle. When the lamps are originally installed, the illumination rises at once to a little above the original candle-power. In about 150 hours this has dropped to the original efficiency, and for the next 500 hours there is a gradual decline to eighty per cent of the original candle-power. Up to this point, as is well known, the illumination is very satisfactory, but when it drops down to something between seventy and sixty per cent, there is a point reached where the lamps are so dim that dissatisfaction is manifest.

The design and construction of the new type of Bryan-Marsh lamp are such that when the lamp crosses the eighty-per-cent line it will burn out. Of course, it is impossible to make an incandescent lamp that will automatically burn out when it reaches the exact eighty-per-cent line. The accompanying curve sheet, which



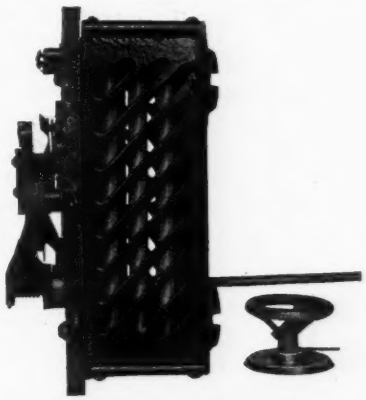
Curve Sheet Showing Test of New Incandescent Lamp.

shows the test made on twenty-one lamps, with an average efficiency of 3.41 watts per candle, points out how near to the eighty-per-cent line the lamps actually burn out. The rating of these lamps was 3.5 watts per candle. The average life to eighty per cent was 813 hours, and the actual average life, 914 hours.

If this condition can be maintained continually, there is no doubt that, in many quarters, a type of lamp having this characteristic will be very well received.

Motor-Starting Rheostats.

The accompanying illustration shows a motor-starting rheostat for rear-of-switchboard mounting, made by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. The apparatus consists of the usual front and resistance, the contacts, etc., on the front being reversed in arrangement to those on the front-of-board apparatus, so that when the starter is mounted on the rear of the switchboard, with the contact parts facing out from the board, the hand-wheel will be moved in the same direction to cut out



Motor-Starting Rheostat.

resistance as is the case with the lever for the front-of-board apparatus.

In addition to this, the contact parts are insulated from the lever and the resistance is rearranged in order to allow space for the passage of the hand-wheel shaft through the resistance and switchboard. This results, in some instances, in a somewhat larger starter than is necessary in front-of-board arrangement, in so far as the external dimensions are concerned; but other than this, the rear-of-board apparatus is arranged for practically the same service and has the same capacity in both front and resistance as the front-of-board type.

The Interborough Rapid Transit Company has contracted for an escalator to be installed at the Thirty-third street station of the Sixth avenue elevated railroad. The escalator will be placed on Broadway just north of Thirty-third street and will carry passengers direct to the downtown station. A footbridge will extend over the tracks to the uptown station and it is anticipated that a majority of the uptown passengers will avail themselves of the escalator and footbridge thus avoiding the laborious climb of the stairway used at present. In connection with this installation, the commendable action of the owners of the department store on the corner in surrendering much of their sidewalk and part of their basement space should be noted.

With a pressure of 100 pounds at the nozzle, one and three-eighths inches diameter, a stream can be thrown vertically 103 feet, and horizontally ninety-six feet. The nozzle will discharge 574 gallons of water per minute. With a higher pressure, equivalent to a higher head, the amount discharged and the distance to which the water may be thrown will be increased.

THE AMERICAN STREET RAILWAY ASSOCIATION.

PROGRAMME OF THE TWENTY-SECOND ANNUAL MEETING, HELD AT SARATOGA, N. Y., SEPTEMBER 2, 3 AND 4.

The twenty-second annual meeting of the American Street Railway Association convened at Saratoga, September 2, 3 and 4. The first session was held on Wednesday at 2 P. M. The following programme had been arranged:

Meeting called to order by W. Caryl Ely, first vice-president.

Address of welcome by Hon. A. P. Knapp, president of the village of Saratoga. Calling of the roll. Address of the president. Report of the executive committee. Report of the secretary and treasurer.

The following papers were scheduled for presentation:

"Steam Turbines." "Electric Welded Joints." "The Evils of Maintenance and Champerty in Personal Injury Cases." "Train Orders and Train Signals on Interurban Roads." Freight and Express on Electric Railways." "The Manufacture of Distribution of Alternating Currents for City Systems." "Comparative Merits of Single and Double-Truck Cars for City Service." "The Right of Way."

Appointment of committee on nomination of officers and selecting of next place of meeting.

THURSDAY, 10 A. M.

Discussion of papers presented to the association. Report of committee on standard rules for the government of employés.

FRIDAY.

Continued discussion on papers presented to the association. Report of committee on standards. Election of officers for the ensuing year.

The following entertainment was provided for the attendants at the convention, and, in addition, two daily concerts by Victor Herbert's orchestra. On Wednesday, at 8 P. M., there was an excursion to Saratoga Casino, the train being drawn by an electric locomotive. On Thursday, at 1 P. M., an excursion was made to Schenectady, to visit the works of the General Electric Company. Friday, at 1 P. M., an excursion was made to Lake George, the train drawn by an electric locomotive. Friday evening, annual banquet at the Grand Union Hotel.

The excursions to Saratoga Casino and Lake George were by courtesy of the Hudson Valley Railway Company. The excursion to Schenectady was by courtesy of the General Electric Company.

Among the exhibitors displaying apparatus at the convention were the following:

American Automatic Switch and Signal Company, Chicago.

American Automatic Switch Company, New York.

American Brake Shoe and Foundry Company, Mahwah, N. J.

American Car and Foundry Company, Chicago.

American Car Seat Company, Brooklyn, N. Y.

Benjamin Electric Manufacturing Company, New York.

Brady Brass Company, New York.

Harold P. Brown, New York.

Bullock Electric Manufacturing Company, Cincinnati, Ohio.

Cheatham Electric Switching Device Company, Louisville, Ky.

Chicago Mica Company, Valparaiso, Ind.

Climax Fence Post Company, Chicago.

Columbus Steel Rolling Shutter Company, Columbus, Ohio.

R. W. Conant, Cambridge.

Consolidated Car Fender Company, New York.

Consolidated Car Heating Company, Albany, N. Y.

Continuous Rail Joint Company, Chicago.

Crouse-Hinds Electric Company, New York.

Dearborn Drug and Chemical Works, Chicago.

Detroit Trolley and Manufacturing Company, Detroit, Mich.

O. M. Edwards Company, Syracuse, N. Y.

Electric Storage Battery Company, Philadelphia.

Electric Railway Equipment Company, Cincinnati, Ohio.

Federal Manufacturing Company, Cleveland, Ohio.

C. J. Field, New York.

General Electric Company, Schenectady, N. Y.

Gold Car Heating and Lighting Company, New York.

Gould Storage Battery Company, New York.

C. J. Harrington, New York.

F. M. Hawkins, New York.

H. W. Johns-Manville Company, New York.

Johnson Wrecking Frog Company, Cleveland, Ohio.

Le Valley Vitae Carbon Brush Company, New York.

National Carbon Company, Cleveland, Ohio.

National Electric Company, Milwaukee, Wis.

Ohio Brass Company, Mansfield, Ohio.

Peckham Manufacturing Company, New York.

Pittsburg Reduction Company, Chicago.

Pittsburg Switch and Signal Company, Pittsburg, Pa.

Robins Conveying Belt Company, New York.

Rossiter, MacGovern & Company, New York.

Speer Carbon Company, St. Mary's, Pa.

Standard Automatic Lubricator Company, Philadelphia.

Standard Paint Company, New York.

Standard Vitrified Conduit Company, New York.

Stanley Electric and Manufacturing Company, Pittsfield, Mass.

Sterling Meaker Company, Newark, N. J.

Sterling Varnish Company, Pittsburg, Pa.

Taylor Electric Truck Company, Troy.

Traction Equipment Company, Brooklyn, N. Y.

Trolley Supply Company, Canton.

Union Signal Company, Cambridge.

United States Electric Signal Company, West Newton, Mass.

United States Steel Company, West Everett, Mass.

Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.

Westinghouse Traction Brake Company, Pittsburg, Pa.

Wheel Truing Brake Shoe Company, Detroit, Mich.

The Meeting of the British Association.

The annual meeting of the British Association will be held at Southport, England, beginning Wednesday, September 9. A large committee has been in charge of local arrangements for some time past, and every indication points that there will be an unusually large gathering and that the attractions provided will be of great value.

Three sections will meet in the Science and Art Schools as follows: Section A, which is in two departments, mathematics and astronomy; Section B, chemistry; and Section G, engineering. Section L, education, will meet in the Cambridge Hall, and Section H, anthropology, will meet in the Town Hall. Two of the corporation committee rooms in the Town Hall have been set aside for the deliberations of the International Meteorological Committee which will meet in Southport at the same time as the British Association. The laboratory of the Science and Art Schools will be used as a meteorological museum and for the reception of apparatus and specimens illustrative of papers communicated to the sections.

The first general meeting of the assembly will be held on Wednesday evening, September 9, at 8.30, in the Opera House, when the president, Sir Norman Lockyer, will deliver his inaugural address.

Excursions will be made to Manchester, visiting the works of the British Westinghouse Electrical and Manufacturing Company at Old Trafford. The new technical school, the John Rylands Library, and the Chetham Hospital will be inspected. A trip will be made to Stonyhurst College and Whalley.

On the concluding day of the meeting, Wednesday, September 16, an excursion will be made to the British Insulated Wire Company's works at Prescot, the Lancashire & Yorkshire Railway Company's works at Horwich and to two collieries at Wigan.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

A POWER PLANT FOR DULUTH—The Great Northern Power Company, of Duluth, Minn., is about to install an electric power plant which it is expected will eventually deliver some 100,000 horse-power. A fall of more than 350 feet vertically is secured by bringing the water down a steep hill in a pipe. Energy is to be furnished for the industries of the city and probably for the mines of the Mesaba range. The first installation will cost about $3,500,000.

VIRGINIA POWER COMPANY TO INCREASE ITS CAPACITY—The Virginia Passenger and Power Company has purchased thirty-six miles of land lying on both sides of the Appomattox river, and will construct a lake thirty miles long and four miles wide, the object being to obtain a full supply of power for the cities of Richmond and Petersburg. It is also proposed to erect a clubhouse and to create a great pleasure resort at this point. It is said that the general plan contemplates the expenditure of several millions of dollars.

NEW CALIFORNIA POWER PLANT—The California Edison Electric Company has started preliminary work on another power plant to be situated on Bear creek. It will be located near the junction of Bear creek and the Santa Ana river, near the headworks of the present power-house in the Santa Ana Cañon. The water of both rivers will be used to furnish power, and by means of an extensive system of tunneling a long pipe line will be established. The power from this plant will be used by the Edison company to supplement the supply which goes to San Bernardino, Riverside, Redlands and Los Angeles.

A CONSOLIDATION SUGGESTED FOR THE CHICAGO TRACTION COMPANIES—A consolidation of all the Chicago street car lines is the solution of the traction problem favored by Judge Grosscup and planned by the Union Traction receivers, according to a statement which has been made by Marshall E. Sampsell, receiver. A basis of one-city-one-fare is considered by the receivers to be the best foundation upon which to ask franchises from the city. The Court favors this plan, and the details will probably be worked out by protective committees representing the Northwest and other companies, together with a voting trust with power to act for the Union Traction Company. The Chicago City Railway will be represented by New York stockholders who favor consolidation and by Chicago shareowners who hold the same views. It is not believed that the one-city-one-fare arrangement would be a heavy burden upon the consolidated company, as it is thought that through travel through the various parts of the city will be comparatively light.

THE COOPER HEWITT MERCURY VAPOR LAMP.

The Cooper Hewitt Electric Company has recently perfected a new method of starting some of the various types of mercury vapor lamps manufactured by it under the Hewitt patents.

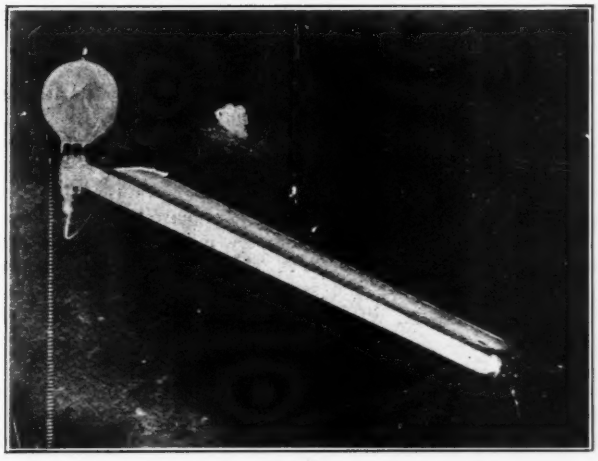
Up to now the lamps put into commercial use were started by a high-potential kick from an inductance coil. A special quick-break switch under oil was used to make and break a circuit across the coil, the discharge of which passed through the lamp, breaking down the initial reluctance to starting.

The new process of starting, which is called by the descriptive name, the "Tilting" method, is somewhat similar to that employed by Arons and other early investigators, in that an absolute connection is established between the two electrodes of the lamp by means of the fluid of the electrodes themselves.

These lamps had two mercury electrodes on the same plane and were started by being turned sideways so that the two pools of mercury came into contact. On being returned to the original position the contact was broken and the conduction through the vapor established.

In the Hewitt lamp, however, the electrodes are placed one above the other and a connection is established by first tipping the lamp so that there is an excess of mercury in the normal upper electrode and then allowing this mercury to flow, by gravity, in a stream down the length of the tube. This stream momentarily establishes a metallic connection between the electrodes and then breaks, usually at the bottom, where it ends in a spray. The lamp lights across the break, the luminous area rapidly extending up the tube as the stream falls away. The liquid mercury has the property of stringing out into a long, fine, continuous stream, and lamps over four feet long have been lit in this manner, using no more mercury than is required for their normal operation. It is usual, however, to use lamps about two feet long to operate on fifty-five or sixty volts. This is the type of lamp here illustrated.

At the upper end is the condensing and regulating chamber, which is one of the distinctive features of the Hewitt lamp. The lamp is supported by two asbestos-lined clamps to a metal tube, through which run the wires to the two terminals. The rod is pivoted in the centre and has a weight at the lower end so that the lamp normally hangs as shown. A chain is provided for pulling the upper electrode down and thus furnishing it with a surplus of mercury. On releasing the chain the lamp returns automatically to its normal position, the stream is formed and



NEW TYPE HEWITT MERCURY VAPOR LAMP.

the conduction through the vapor established. A spring and cushion at the pivot prevent any jar. An adjustable reflector is strapped to the supporting rod.

To operate 110 to 120 volts, the lamps are connected two in series. If it is intended to light both lamps simultaneously they are mounted in one frame and tilted together. With an apparatus of this kind, a simple rheostat and choke coil for steadying resistance are all that is required. When the lamps are to be lighted independently, each is furnished with a resistance having in shunt across the vapor lamp another resistance which is automatically cut out when the lamp is started. Two forty-volt, 1.5-ampere incandescent lamps are used as the shunt, so that being first turned on by an ordinary switch the operation of tilting the vapor lamp may be readily accomplished in an otherwise dark place. They also serve as pilot lamps to show when the switch is left closed and the vapor lamps unlit.

Besides the lamp illustrated, the company is manufacturing two other types of Tilting lamps. Both are mounted in double holders and are intended to be lit simultaneously. One set consumes but 1.3 amperes and is intended for retouching and lantern slide work, etc., while the others are the regular three-ampere lamps and are arranged for all sorts of photographic and printing work.

In spite of the distortion of colors produced by the light, the lamp is finding much favor as an illuminant for offices where close application is required.

The company has recently installed vapor lamps for lighting the composing-room of the New York *Evening Post* and the train despatcher's office of the Pennsylvania Railroad at Jersey City, N. J.

PERSONAL MENTION.

MR. S. L. BARRIETT.

MR. S. L. BARRIETT is the designer of the well-known Cincinnati motor, and the inventor of the automatic-release rheostat and self-oiling bearing, two inventions which have been utilized with the greatest practical benefit in connection with the operation of electric motors. Mr. Barriett was general master mechanic of West Point foundry during the late Spanish American War, and is recognized as an authority on electrical and mechanical matters generally. While associated with the Sprague Electric Company, Mr. Barriett worked out various controlling devices for that company, leaving this connection in 1896, when he took charge of the tool-designing at the West Point foundry, shortly after being promoted to the position of general master mechanic. Shortly after the war Mr. Barriett resigned his position at the West Point foundry and came to Cincinnati, organizing the Cincinnati Electric Motor Company, designing special tools and machinery for the manufacture of electric motors ranging from one-half to ten horse-power. This institution has been very successful, and on July 1 it was decided to change the name to the Barriett Electric Company. The Barriett Electric Company will manufacture the Cincinnati motor and also a new type of motor which Mr. Barriett is designing, and which will be known as the Barriett motor.

MR. G. WILBUR HUBLEY, superintendent and electrical engineer of the Louisville Lighting Company, Louisville, Ky., made a brief visit in New York city last week on his return from Atlantic City.

MR. WILLIAM S. BARSTOW, the well-known consulting engineer, New York city, has moved his headquarters to the Bowling Green offices, 11 Broadway. Mr. Barstow makes a feature of giving periodical and special reports on electrical properties, prepares plans and specifications, and supervises installations.

MR. CHARLES H. WILLIAMS, of the Madison Gas and Electric Company, Madison, Wis., will be in charge of the wrinkle department of the National Electric Light Association. Mr. Williams was suggested by past-President Doherty, and will make this subject of value and interest to the members of the association.

MR. GEORGE C. EWING has been appointed the New England representative of the Cooper Hewitt Electric Company, of New York city, to handle the Hewitt mercury vapor lamp in his territory. This is not a change from his present business, but an addition to it. Mr. Ewing's headquarters are the Board of Trade Building, 131 State street, Boston, Mass.

MR. T. F. MANVILLE, president of the H. W. Johns-Manville Company, and family returned on August 20 from a two months' trip abroad, visiting London, Paris, Berlin and other places on the Continent. Mr. Manville was largely interested in numerous important tests of the efficiency of pipe-coverings conducted by the English Government, and feels confident of closing some large contracts as a result.

MR. LARUE VREDENBURGH has been appointed reporter on advertising methods, and will present a report on this subject at the twenty-seventh annual convention of the National Electric Light Association, to be held in Boston, May, 1904. Mr. Vredenburgh is in charge of the Edison Electric Illuminating Company's exhibition department in Boston, and this is one of the most complete of its kind in the country.

MR. FRANCK Z. MAGUIRE, of New York and London, has been elected vice-president of the DeForest Wireless Telegraph Company. Mr. Maguire was formerly associated with Thomas A. Edison and Alexander Graham Bell in electrical work and will be a valuable member of the DeForest company. Mr. Maguire has numerous electrical interests in this country and Great Britain and crosses the ocean several times every year.

MR. RUSSELL HOWLAND, for several years assistant advertising manager of the ELECTRICAL REVIEW, has recently resigned to open a business office at 150 Nassau street, New York city. It is Mr. Howland's intention to take charge of general advertising for his patrons and its systematization, this service to include the preparation of original copy and literature and a system of following up enquiries. His experience should win him pronounced success in this field. The ELECTRICAL REVIEW extends to Mr. Howland its best wishes for his success.

ELECTRIC RAILWAYS.

WATERTOWN, N. Y.—It is rumored here that the street car line into Dexter will next year be extended to Guffins Bay, to handle both a freight and a passenger business.

SOUTH BEND, IND.—The Northern Traction Company has been incorporated to build an electric railroad connecting the cities of South Bend, Laporte, Valparaiso and Hammond.

DOYLESTOWN, PA.—Rights of way for the extension of the Philadelphia & Easton Railway Company's line from Tohickon Park to Bedminster, three miles, have been secured, and work will commence shortly. The extension will cost about $50,000.

BURLINGTON, IOWA—Plans have been made for the construction of an interurban electric line from this city to Keosouqua. Corporate articles have been filed by the Burlington Interurban Company, with $200,000 capital stock. Carl Liepold is president and J. W. Topping, secretary.

DOYLESTOWN, PA.—It is said on good authority that a trolley road will be built between Newton and Willow Grove at an early date. The route between the two places has been decided on and considerable of the right of way secured. The line will take in the villages of Richboro, Southampton, Davisville and Hatboro.

MINEOLA, N. Y.—The board of supervisors has unanimously granted the Mineola, Roslyn & Port Washington Traction Company a franchise over the country roads included in the proposed trolley route from Mineola to Port Washington. Under the conditions of the franchise the company is required to begin work not later than January 1 next and complete the road on or before June 1, 1904.

LOUISVILLE, KY.—The Southern Kentucky Interurban Traction and Power Company has been incorporated in New Jersey for the purpose of building an electric railroad from Bowling Green to Hopkinsville, *via* Franklin, Russellville and Elkton. The company is now acquiring right of way between the terminals of the proposed line, most of it having been already secured. The company's capital is $125,000.

SHARON, PA.—The officials of the Cleveland & Sharon Electric Railway have awarded the contract for the construction of the line from Middlefield to Sharon, a distance of forty-five miles, to Joyce, Heasley & Fawcett, of Youngstown, for $200,000. The line is now in operation from Cleveland to Middlefield. In addition to the line from Middlefield to Sharon, another is to be built by the same company from Kinsman through to Warren, Ohio, and the line is also to be extended northeast from Kinsman to Greenville and Meadville.

LITTLE ROCK, ARK.—The state board of railway incorporators has granted a charter to the Little Rock & Monroe Railway Company, which will probably furnish the connecting link in a new line from Little Rock to New Orleans. The capital stock is $500,000. The proposed line is to be about fifty miles in length, extending from Felsenthal, Ark., to Monroe, La. It will probably cross the Ouachita River at Ouachita City, La. The directors of the company are: C. D. Johnson, president, St. Louis; E. A. Frost, Texarkana, Ark.; E. W. Frost, Texarkana, Ark.; J. F. Rutherford, Pine Bluff, Ark., and J. E. Cavanagh, Lapile, Ark.

PAWTUCKET, R. I.—If present plans are carried out, work will commence next year on the construction of a double-track electric railroad between Woonsocket and Providence, by the new Providence & Burrillville Street Railway Company. The line will start from a point south of Woonsocket and will run through North Smithfield, Lincoln and Smithfield to a point near Centredals, connecting there with the tracks of the Providence system. The distance between Providence and Woonsocket by steam road is sixteen miles, and the promoters of the plan hope to cut this down two or three miles. The company will handle both passengers and freight and will also do an express business.

ELECTRICAL SECURITIES.

Contrary to expectations, the price changes during last week amounted to very little. The total dealings were lighter than in any week for some time, and it is stated that on Thursday the record was made for the smallest dealings in two years. While this was hardly expected, dulness at this time is the rule. The general prosperity of the country is admitted, and at this time it seems hard to reconcile the prevailing opinion that a decline in values is the forerunner of a decline in industrial activity.

The money market appears to be in a stronger position than the adverse speculative conditions of the past few months would seem to warrant. This, however, is due to the radical measures which government officials have taken to provide against a protracted stringency. The announcement has been made that Secretary Shaw has accumulated from internal revenue receipts a fund of $40,000,000, which will be thrown into the local money market in case of necessity. This, of course, relieves the banking community of any uneasiness, and it is also known that the greater number of banks are in a stronger position than they have been for several years.

Railroad earnings, which are taken more or less as the index of industrial conditions, show an unabated prosperity. Some companies which were not expected to do very well have shown, in balancing up their books, that the earnings have been beyond the most sanguine expectations.

ELECTRICAL SECURITIES FOR THE WEEK ENDING AUGUST 29.

New York:	*Closing.*
Brooklyn Rapid Transit	45¾
Consolidated Gas	178
General Electric	163
Kings County Electric	150
Manhattan Elevated	135½
Metropolitan Street Railway	114
New York & New Jersey Telephone	148
Westinghouse Manufacturing Company	175

The annual report of the Brooklyn Rapid Transit Company for the year ended June 30, 1903, shows the gross earnings to have been $12,357,041, and the expenses, $7,553,939, leaving net earnings of $4,803,102. The total income of the company amounted to $5,025,491, and the charges to $4,289,907, leaving a surplus for the year of $735,584, as compared with a deficit of $129,156 for the preceding year.

Boston:	*Closing.*
American Telephone and Telegraph	133
Edison Electric Illuminating	230
Massachusetts Electric	81
New England Telephone	125
Western Telephone & Telegraph preferred	80

It is estimated that the earnings of the American Telephone and Telegraph Company this year will be about 10 per cent on the stock eligible for dividends, and about 8 per cent on the total stock outstanding. The direct net earnings of the company from its long-distance service this year will probably be at least $2,000,000, against $1,800,000 last year.

Philadelphia:	*Closing.*
Electric Company of America	8⅝
Electric Storage Battery common	56
Electric Storage Battery preferred	56
Philadelphia Electric	6¼
Union Traction	43¾
United Gas Improvement	84

The stockholders of the Union Traction Company will hold their annual meeting on September 16.

Chicago:	*Closing.*
Chicago Telephone	122
Chicago Edison Light	140
Metropolitan Elevated preferred	60
National Carbon common	20
National Carbon preferred	88
Union Traction common	4¼
Union Traction preferred	32

The directors of the South Side Elevated Railroad have declared the regular quarterly dividend of 1 per cent, payable September 30. Books close September 19 and reopen October 1.

ELECTRIC LIGHTING.

SAUK CITY, WIS.—A contract has been made with a Madison firm for an electric lighting and power plant for this town, to cost $9,000. This does not include the building.

HUNTINGTON, W. VA.—Work on the new power station for the Camden Inter-State Railway at Kenova has been commenced and the new station will be completed as soon as possible. The building, when completed, will have cost $2,000,000.

NIAGARA FALLS, N. Y.—The common council has accepted the bid of the Buffalo & Niagara Falls Electric Light and Power Company to light the city streets. The city is to use not less than 400 arc lights, at $65 a light, and the contract is to run for a period of five years.

JANESVILLE, OHIO—The Acme Electric Light and Power Company has been incorporated with a capital of $10,000, to furnish Crooksville with light and power. The incorporators of the company are Ellwood Newberry, Lewis Springer, H. F. Kinnen, W. H. Dunn, A. E. Smith and J. J. Hill.

GRAND RAPIDS, MICH.—The Grand Rapids Edison Company's plant at Lowell is said to be nearing completion. The plant, which will cost $500,000, is located two miles north of Lowell in Vergennes township. The electricity will be used largely in Grand Rapids for lighting, heating and power.

APPLETON, WIS.—The United Gas and Electric Corporation, of which Thomas A. Rockwell, president of the Fox River Valley Gas and Electric Company, is chairman, has purchased the gas and electric interests at Ishpeming. The property includes the electric light and gas plants of Negaunee and Ishpeming and an interurban electric railway between them.

DUXBURY, MASS.—It is stated that a proposition is under way for the formation of a stock company of Boston capitalists to furnish light for Duxbury, Standish Shore, Duxbury Beach and Green Harbor village, possibly extending the system through Brant Rock, and that more than $50,000 has been subscribed for the purpose. The company, if present plans materialize, will probably furnish power for electric lines that may be built through the South Shore beaches.

TROY, N. Y.—Articles of incorporation for the Hoosic Electric Light and Power Company have been filed in the office of the county clerk. The capital stock of the company is $50,000, and the directors are Le Grand G. Tibbits, George A. Bovie and Sayre McLeod. The company will do business in Renssalaer, Washington, Albany and Saratoga counties, operating particularly in Schaghticoke, Pittstown, Hoosick and Hoosick Falls, White Creek, Cambridge, Jackson, Easton, Greenwich, Petersburgh, Valley Falls, Johnsonville, Eagle Bridge, Green Island, Waterford, Troy, Albany, Cohoes, Rensselaer and Watervliet. The field of operation may be extended to all parts of the state, and the company's equipment, it is said, will be sufficient to do municipal lighting and to furnish light and power to large industrial concerns.

LEGAL NOTES.

SUIT FOR INFRINGEMENT OF CLEANING AND COATING PROCESS—The Safety Armorite Conduit Company, Pittsburg, Pa., a large manufacturer of the enameled type of iron-armored electric conduits, has brought a suit in the United States Circuit Court for the Western District of Pennsylvania against the American Conduit Manufacturing Company, of New Kensington, Pa., alleging an infringement of a patent for a cleaning and coating process.

TIME LIMIT ON TRANSFERS—The Supreme Court of Maryland has held in the case of Garrison *vs.* United Railways and Electric Company (55 Atlantic Reporter 371) that a statute of the state requiring the street car company of Baltimore city to give on request to each passenger paying a cash fare for a "continuous" ride a transfer, does not prohibit the company from limiting the time within which a transfer can be used. It was further held that when the time limit of a transfer issued by the street railway has expired, the transfer is void on its face, and the conductor is justified in refusing to honor it and in demanding a fare. It was also decided that when a conductor has given a passenger a reasonable time and opportunity to pay his fare and the passenger has refused, and the conductor has commenced to eject the passenger, the ejection may be completed even though a fare be tendered, as the passenger has forfeited his rights as such.

INDUSTRIAL ITEMS.

THE SPRAGUE ELECTRIC COMPANY, 524 West Thirty-fourth street, New York city, in its bulletin No. 206, describes a line of Lundell motors for direct current. This includes round-top motors, open and enclosed; medium-speed, six-pole, single-field-coil motors; and slow-speed, six-pole, single-field-coil motors.

THE BUREAU OF EXPERT INVESTIGATION AND CONSTRUCTION, 35 Nassau street, New York city, has issued an attractive folder setting forth the functions of the organization. This consists of specifications on electrical, mechanical, hydraulic, civil, mining and factory engineering problems, and research into chemical problems. There is also a law department, and a department of patents and patent law.

THE DOUBLEDAY-HILL ELECTRIC COMPANY, Pittsburg, Pa., is supplying the electrical apparatus for the new Grand Opera House, in Pittsburg, which is being entirely redecorated. The work is being done by the Fullman Company, which is installing its new floor box. This will be described later. The large dimmer for this installation is of the Wirt type, manufactured by the Wirt Electric Company, Philadelphia, Pa.

THE OTIS ELEVATOR COMPANY, 71 Broadway, New York city, has secured an order from the Navy Department for an electric dumb-waiter with push-button control, to be installed on the United States receiving ship Hancock. The car will run from the gallery on the lower deck to the messroom on the upper deck, with a third landing at the deck midway. The rated capacity of the dumb-waiter will be 250 pounds, at seventy-five feet per minute, and the car travel will be thirty feet.

THE VARLEY DUPLEX MAGNET COMPANY, Providence, R. I., has issued its catalogue No. 10B. This contains descriptions and illustrations of electromagnets and all kinds of coil windings of insulated and bare wire. A supplement to this work, which is a valuable contribution to the literature on this subject, has two curve sheets showing the relation between ampere-turns and pull in pounds for different air-gaps, and also showing the relation between pull in pounds and air-gap for various ampere-turns.

THE CROUSE-HINDS ELECTRIC COMPANY, Syracuse, N. Y., is marketing a fine line of "Norbitt" electric specialties. These "Norbitt" porcelains are well known to the electrical trade, and eastern visitors are invited to enquire at the New York office, 23 Dey street, where a full stock is carried. A new catalogue which has just been issued by the company will give a good idea of the extensive line covered by the "Norbitt" specialties, and this will be sent to any one interested upon request to the company.

THE PHOENIX GLASS COMPANY, New York, Pittsburg and Chicago, has just issued a handsome catalogue on electric and gas globes and shades. This catalogue, which is known as No. 15, is 14 by 12 inches in size, consists of 108 pages, fifty-four plates, with over 1,000 artistic designs of globes and shades for gas, electric or combination fixture and bound in heavy green cloth with handsome decorations and lettering in silver. Every color and period of design to harmonize, not only with the chandeliers but with the interior decorations as well, are shown.

THE WESTERN ELECTRIC COMPANY, Chicago, Ill., in its bulletin No. 6005 illustrates a new line of automatic circuit-breakers for direct currents. The company states that the current-carrying parts will not rise in temperature more than twenty degrees above the surrounding atmosphere. The breakers are tripped by a simple electromagnet device. There is ample copper in the laminated brushes and in the coils, and the endeavor has been made to construct a breaker which will possess reliability, simplicity and strength. This handsome bulletin will be sent on request.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., manufacturer of electric light supplies, has recently purchased a pottery, and this, with the expansion of its electrical supply business, has necessitated the active services in its home office of its secretary, E. A. Jenkins. Mr. Jenkins has heretofore had charge of the western office of the company, with headquarters at 190 South Desplaines street, Chicago, Ill. The H. T. Paiste Company has secured the services of James Wolff, western sales manager of the New York Insulated Wire Company, who will conduct the former company's western business at the same address, in connection with his present well-known wire line.

THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, Chicago, Ill., has secured a contract from the New Home Company, of Linton, Ind., for an 800-line switchboard with an ultimate capacity of 3,000 instruments. The contract includes the telephones. The satisfactory results which the Kellogg company's apparatus has given in the plant of the Knox County Telephone Company, of Vincennes, Ind., have caused the directors of the New Home Company, of Linton, part of whom are on the board of directors of the Knox County Telephone Company, to purchase an exact duplicate of the Vincennes board.

THE AUTOMATIC ELECTRIC COMPANY, Chicago, Ill., reports that it is now installing the following plants with the Strowger automatic telephone apparatus: Citizens' Telephone Company, Grand Rapids, Mich., 5,000 stations; Northeastern Telephone Company, Portland, Me., 2,500 stations; St. Marys Telephone Company, St. Marys, Ohio, 500 stations; Cleburne Telephone Company, Cleburne, Tex., 640 stations; Southern Telephone Construction Company, Columbus, Ga., 700 stations; University of Illinois, Urbana, Ill., 50 stations; University of Chicago, 50 stations; Armour Packing Company, St. Louis, Mo., 45 stations; Union Telephone Company, Woodstock, New Brunswick, Canada, 110 stations. All of these equipments will be in operation within a few weeks.

THE EWING-MERKLE ELECTRIC COMPANY, St. Louis, Mo., is mailing an attractive folder which calls attention to its great facilities for promptly taking care of orders of any magnitude. The illustration is a clever drawing of a young woman in military costume, and impresses forcibly the foreword, "Military Promptness." The company states that its corps of able assistants is at headquarters for its patrons' command, and that each assistant is trained to fulfil his part with care and promptness. Every order will have immediate attention, so that not a moment will be lost. At the head of every department is a lieutenant capable of commanding his special post. All goods are carefully packed, and there is little danger of accident en route. The company will be pleased to send its green-book or special bulletins on request.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, has secured an order from the Cincinnati & Columbus Traction Company, Cincinnati, Ohio, through its Cleveland branch, for sufficient overhead line material to build fifty-five miles of new road. The construction will consist of parallel trolley wires of 000 grooved type. The well-known Johns-Manville extra heavy galvanized round-top hangers with three-quarter-inch studs, provided with deep petticoats, will be used, ensuring high-class surface insulation. These insulators are attached to galvanized straight-line yokes having a centre dimension of six inches between trolley wires. The combination mechanical and solder clip, fifteen inches in length, being one piece only, which has proven very successful in the East in extra heavy construction, will also be used in conjunction with the extra heavy hangers and "Giant" type pullovers. "Giant" strain and "Philadelphia" section insulators will be used throughout.

THE AMERICAN ELECTRICAL HEATER COMPANY, 17-19 Spencer street, Detroit, Mich., has issued its new catalogue, which illustrates and describes a fine line of electrical heating apparatus. This takes in a great many devices which are of constant use in industrial and domestic service. The apparatus manufactured by the company has been in successful use for over nine years, and the sales to-day are larger than at any previous time. One of the devices of great practical value made by this company is its electric soldering iron for fine work. A special type of this device is known as the telephone iron for switchboard work. A tip can be used with this iron that will extend four or five inches beyond the end of the iron, and the tips can be removed and forged into any angle desired. This iron can be attached to a lamp socket and used with any length of cord, which will allow it to be carried to any part of the room. The company also makes a larger number of laundry and pressing irons and automatic cutouts and auxiliaries for this apparatus. Another feature is the electric disc heaters or portable stoves. These are also made in a great many shapes, along with griddles, toasters, plate warmers, curling-iron heaters, glue pots, foot warmers, rheostats, shoe-ironing tools, etc. The company's catalogue will be mailed to any one interested upon request.